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ABBREVIATIONS

CDC	Center for Disease Control
EPA	Environmental Protection Agency
GAO	General Accounting Office
HHS	Department of Health and Human Services
NEIC	National Enforcement Investigations Center
NSF	National Science Foundation
OSTP	Office of Science and Technology Policy, Executive Office of the President
PBB	polybrominated biphenyl
RCRA	Resource Conservation and Recovery Act of 1976

MAY 13 1981

Item 546-D

GAI-13:CED-81-57

REPORT BY THE

Comptroller General

OF THE UNITED STATES

ORIGINAL

Hazardous Waste Sites Pose Investigation, Evaluation, Scientific, And Legal Problems

Not much is known about the possible adverse health and environmental effects associated with the thousands of hazardous waste disposal sites now being discovered throughout the United States.

The Environmental Protection Agency is finding it difficult to carry out its mandate to protect human health and the environment from hazardous wastes because:

--New waste sites are being discovered faster than they can be investigated and evaluated.

--There is no strong scientific basis for determining risks.

--Legal action seeking correction of hazardous waste problems is pursued for only a few sites.

Individuals seeking relief within the courts to satisfy hazardous waste compensation claims face great difficulties.

New "superfund" legislation will provide some help, but it is too early to tell whether it will solve all of the problems presented by uncontrolled hazardous waste sites.

CED-81-57

APRIL 24, 1981

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COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON D.C. 20548

B-200084

The Honorable John D. Dingell, Chairman
Subcommittee on Oversight and
Investigations
Committee on Energy and Commerce
House of Representatives

The Honorable Albert Gore, Jr.
House of Representatives

As requested in July 12, 1979, and October 22, 1979, letters from the former Chairman, Subcommittee on Oversight and Investigations, House Committee on Interstate and Foreign Commerce, and Congressman Albert Gore, Jr., and subsequent discussions with their offices, this report discusses the kind of scientific evidence necessary to determine whether or not a particular disposal site poses a significant hazard to the public's health. It also discusses the capacity to collect and substantiate the kind of evidence required to prove the presence of a hazard or the presence of a relationship between a disposal site and impaired health. This review, which began on March 23, 1980, focused on activities performed primarily by the Environmental Protection Agency. An earlier report, "Hazardous Waste Disposal Methods: Major Problems with Their Use" (CED-81-21, Nov. 19, 1980), responded to other concerns emanating from this same request.

As arranged with your offices, we are sending copies of this report to other congressional committees; the Director, Office of Management and Budget; the Administrator, Environmental Protection Agency; the Secretary, Department of Health and Human Services; and the Director, National Science Foundation. Copies are also being sent to appropriate interested parties and will be available to others upon request.

Milton J. Socolar

Acting Comptroller General
of the United States

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REPORT BY THE
COMPTROLLER GENERAL
OF THE UNITED STATES

HAZARDOUS WASTE SITES POSE INVESTIGATION, EVALUATION, SCIENTIFIC, AND LEGAL PROBLEMS

D I G E S T

Hazardous waste sites have been referred to as "ticking time bombs" with the potential to cause untold damage to human health and the environment. The Environmental Protection Agency (EPA) is charged by the Resource Conservation and Recovery Act with protecting human health and the environment from these wastes.

To carry out this mandate, EPA is to (1) discover, investigate, evaluate, and respond to uncontrolled hazardous waste sites, 1/ (2) perform hazardous waste research, and (3) seek solutions to hazardous waste problems and, if necessary, file suit in Federal courts.

EPA has had difficulty in fully performing these activities for a number of reasons. For example, EPA's

--site investigation and evaluation activities lag behind an ever-increasing number of potential sites requiring investigation and evaluation (see ch. 2),

--capabilities to identify and analyze hazardous waste and understand the real or potential risk these wastes pose to human health and the environment are limited by both cost and scientific knowledge (see ch. 3), and

--past enforcement and cleanup efforts were limited by resources required to demonstrate potential harm in a court case and by the need to identify financially viable defendants (individuals or companies) to pay for remedial measures or cleanup costs. (See pp. 36 to 39.)

1/Any area where wastes have been disposed of without adequate measures for controlling the release of hazardous substances into the environment.

EPA is not alone in experiencing difficulties in dealing with the problems posed by hazardous waste. Individuals alleging harm from hazardous waste exposure are finding it extremely difficult to prove harm under common law. Various compensation alternatives to resolve this situation have been proposed by Members of Congress and suggested by others, but none has been adopted. (See ch. 5.)

SUPERFUND IS ENACTED

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (Public Law 96-510)--commonly referred to as "superfund"--was signed by President Carter on December 11, 1980. The act provides for a $1.6 billion fund to be accumulated over the next 5 years that will allow EPA to go in and clean up spilled toxic wastes and hazardous waste sites first, then try to recover the cleanup costs later from responsible parties. It also provides for a program to identify and investigate sites.

While superfund is a positive step, it is too early to determine whether it will provide the total resources needed to identify, investigate, and clean up the sites existing today and those that might be discovered later. Superfund implementation planning provides an opportunity, however, to examine these issues. (See pp. 1, 14 to 15, and 39 to 42.)

RESOURCES TO INVESTIGATE SITES NOT DETERMINED

As of December 31, 1980, EPA had identified 8,677 potential hazardous waste sites. Each site must be evaluated before determining whether a problem does or does not exist. Although several million dollars are being spent on this, preliminary work (collection of data without actually visiting the site) had not been performed on over 3,400 sites.

Once the preliminary work is over, more extensive action--site inspections and field investigations--may be needed. Final decisions as to whether no action is required, remedial action is needed, or enforcement action is needed have been made for only 1,680 sites.

EPA was identifying over 400 new potential sites each month, creating even greater demands for

available investigation and evaluation resources. EPA has not determined the total resources needed for site investigation and evaluation. (See ch. 2.)

SCIENTIFIC KNOWLEDGE LIMITS SITE ASSESSMENT CAPABILITIES

After waste sites are identified, EPA must determine the specific hazardous wastes present and their potential impact on human health or the environment. Unfortunately, EPA has only limited capabilities to do this. Much of the problem is attributed to state-of-the-art limits--hazardous waste and hazardous waste sites present new and unique challenges for which a strong scientific data base is simply not available at this time. EPA needs to know more about (1) screening samples of materials taken from sites to determine whether they are hazardous, (2) the health effects, especially chronic effects, caused by hazardous waste, and (3) the transport and fate of hazardous substances as they migrate through the environment. (See ch. 3.)

ENFORCEMENT IS LIMITED

Through enforcement actions filed in U.S. Federal district courts by the Department of Justice, EPA is attempting to compel some individuals and companies to clean up hazardous waste sites. These actions have been limited, however, by resources, the time it takes to develop a case and pursue it in the court system, and the defendant's ability to pay cleanup or other costs. Superfund will affect these issues, but it is difficult to say how much.

As of December 31, 1980, EPA had filed 55 enforcement cases and had over 200 sites under investigation for potential enforcement action. Such action has been only a partial answer to the cleanup problem. (See pp. 36 to 39.)

VICTIM COMPENSATION ISSUES

There are no easy solutions to the problem of what can be done legally for alleged victims of hazardous waste exposure. The National Science Foundation is now conducting a study to determine the extent to which scientific knowledge about the cause of pollution-induced diseases can be used to develop and implement victim compensation programs.

Furthermore, the superfund legislation requires a study to determine the adequacy of existing common law and statutory remedies in providing legal redress for harm to individuals and the environment caused by the release of hazardous substances into the environment. (See ch. 5.)

RECOMMENDATIONS TO THE ADMINISTRATOR, EPA

In planning to implement the superfund legislation and for use in future budgeting, the Administrator, EPA, should provide an estimate of:

--The total EPA resources needed to investigate and evaluate potential hazardous waste sites. The estimate should be based on those sites currently known to need investigation and evaluation and those that are projected to need such action in each of fiscal years 1981 through 1985. (See p. 15.)

--The amount of resources needed to clean up and respond to hazardous waste sites. Such amount should be based on those sites currently known to need cleanup or response action and those that are projected to need such action in each of fiscal years 1981 through 1985. It should also include estimates of how much the fund will be replenished by responsible parties. (See p. 43.)

Further, the Administrator should assess how the Federal Government can expand its enforcement efforts at uncontrolled hazardous waste sites. If additional resources or increased legislative authority are among the alternatives, the Administrator should provide such information to the Congress for its consideration. (See p. 43.)

The Administrator should also evaluate ongoing EPA hazardous waste research programs relating to biological testing, health effects, and transport and fate of hazardous substances as they migrate through the environment to determine what actions can be taken to increase EPA's efforts in these areas. As part of the evaluation EPA should specify where joint EPA and Department of Health and Human Services research projects should be encouraged. (See pp. 33 to 34.)

AGENCY COMMENTS

EPA stated that the report makes many constructive criticisms and presents a balanced evaluation of a most difficult environmental problem. It added that the problem is large, complex, resource intensive, and not yet fully defined. Furthermore, EPA stated that the report properly identified many of the scientific needs and problems and properly pointed out the difficulties of taking strong enforcement positions in the absence of legislative authority in new areas. (See app. II.)

EPA did not clearly address GAO's recommendations. Only in the research area, however, did EPA appear to disagree with the GAO recommendations. EPA stated that the order of priorities determined by the report as suitable for research and development activities is not consistent with the order determined by EPA's internal management. GAO did not determine an order of priorities but has clarified its wording. GAO believes that EPA has not adequately considered the merits of the research recommendations. (See p. 34.)

The National Science Foundation stated that it had no objections or comments on the report. (See app. III.)

The Department of Health and Human Services did not provide official comments.

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PBB	polybrominated biphenyl
RCRA	Resource Conservation and Recovery Act of 1976

CHAPTER 1

INTRODUCTION

The real and potential problems posed by improperly managed hazardous waste sites are enormous. Hazardous waste is seeping into the Nation's groundwater supplies, contaminating its land, and escaping into the air. The rapid rate at which reports of damage are being accumulated suggests that these sites present problems of awesome proportions, constituting perhaps the single most important environmental issue of the decade. Costs to clean up the problems presented by such sites have been estimated to range from $4 billion to over $50 billion. The problem has been called a "sleeping giant," and individual sites have been referred to as "ticking time bombs" with the potential to cause severe damage to human life and the environment.

Subtitle C of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act of 1976 (RCRA), directs the Environmental Protection Agency (EPA) to promulgate regulations to protect human health and the environment from the improper management of hazardous waste. 1/ It establishes a Federal program to provide comprehensive regulation of hazardous waste. Initial regulations were promulgated in 1980; additional regulations are to be issued in the future. When fully implemented, this program is envisioned to provide "cradle-to-grave" regulation of hazardous waste which should, if properly carried out, prevent improper disposal of future hazardous waste. RCRA also gives the EPA Administrator broad powers in the hazardous waste enforcement area. For example, it authorizes the EPA Administrator to go to Federal court and seek the abatement of a hazardous waste problem if he determines that the transportation, generation, storage, disposal, or treatment of such waste presents an imminent and substantial endangerment to health or the environment.

SUPERFUND LEGISLATION ENACTED

One piece of legislation, in addition to RCRA, affecting the problems posed by improperly managed hazardous waste sites is the so-called "superfund." This legislation, the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (Public Law 96-510), was signed by President Carter on December 11, 1980. Superfund was conceived from the need for a revolving

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1/Defined under RCRA as a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may (a) cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or (b) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed.

fund that would allow EPA to go in and clean up hazardous waste sites first, then try to recover the costs of such cleanup later from the responsible parties. The legislation is structured to complement, not eliminate, existing laws governing hazardous waste and gives an incentive for responsible parties to voluntarily mitigate the damage from this waste. It is also designed to give the Government the resources needed to clean up dump sites where the perpetrator is unknown; the perpetrator cannot be located, cannot afford to clean up, or declares bankruptcy and walks away from the site; or the responsible company was dissolved long ago. Further, it provides for the costs of a program to identify, investigate, and take enforcement and abatement action against releases of hazardous substances.

The superfund legislation provides for a $1.6 billion fund over the fiscal year 1981-85 period for these purposes. It also provides that those who own or operate waste disposal sites, produce wastes, or transport them are liable for all cleanup costs and for up to $50 million for each incident of damage to natural resources owned or controlled by State or Federal Governments. The act provides no compensation whatever to persons injured in such incidents, however. They must pursue compensation in the courts. The act also creates a new agency within the Public Health Service to be known as the Agency for Toxic Substances and Disease Registry, which shall report directly to the Surgeon General of the United States. Among other things, this new agency will be responsible for establishing and maintaining an inventory of literature, research, and studies on the health effects of toxic substances.

THOUSANDS OF HAZARDOUS WASTE SITES POSE A DANGER TO HEALTH AND THE ENVIRONMENT

Although no generally accepted figure exists on the number of hazardous waste sites, there is widespread agreement that many of these sites constitute potential major health and environmental threats. For instance, a 1979 EPA-contracted study estimated that somewhere between 32,000 and 51,000 sites may contain hazardous wastes, of which 1,200 to 2,000 could pose potential danger to health and/or the environment. As of December 31, 1980, EPA had identified 8,677 potential hazardous waste sites with over 400 additional sites being found each month.

Of particular concern are those hazardous waste sites that have been labeled uncontrolled 1/ and which pose potential threats to the public health or the environment. EPA simply does not know how many uncontrolled hazardous waste sites exist in the United States.

1/Any area where wastes have been disposed of without adequate measures for controlling the release of hazardous substances into the environment.

What are the dangers?

The dangers posed by uncontrolled waste disposal sites can be divided into short-term (acute) health effects, long-term (chronic) health effects, and environmental damage. The impact of environmental and health damage can be devastating, including serious economic loss, high health care costs, compensation to affected individuals, and property loss, as well as the indirect costs of human suffering and the long-term loss of valuable natural resources. The following examples are illustrative.

--In 1972 unsafe levels of the toxic chemical hexachlorobenzene were discovered in a routine sample of beef from a cattle ranch in Louisiana. Further investigation revealed that about 30,000 head of cattle within a 100-square-mile area also had unsafe levels of this chemical in their tissues. Apparently, it had been disposed of at a nearby industrial dump and was volatilizing and being spread throughout the local area by air currents. Local residents also showed unusually high blood levels of it. Although no human health effects have been reported from this incident, chronic symptoms from exposure to this toxic chemical have included liver enlargement, weight loss, bone deterioration, and death.

--In 1978 a fire broke out at a disposal site in Chester, Pennsylvania, where several thousand deteriorating drums of reactive and toxic chemicals were being stored. Forty-five firemen had to be treated for health effects and injuries, mostly due to direct contact with toxic fumes and chemicals. Several smaller fires have broken out since that date, and the site continues to pose a threat of fire, explosion, and toxic fumes to local residents.

--In Hardeman County, Tennessee, pesticide residues began to leak from deteriorating drums at an industrial waste disposal site and to contaminate groundwater in the local area with a variety of toxic chemicals, including the pesticides Endrin, Dieldrin, Aldrin, and Heptachlor. Forty families who drank contaminated well water experienced a variety of health effects, including liver and urinary tract problems, nausea, dizziness, and rashes. The affected families have filed a $2.5 billion suit against the pesticide manufacturers.

These examples are not unique. Hundreds of others exist where environmental and human health damage have been caused by uncontrolled sites. These include highly publicized incidents, mentioned above, and many others, less well known, which have had equally severe effects.

WHEN DOES A SITE POSE A HAZARD?

Considering whether a site is or is not a hazard requires an investigation and evaluation of its contents, characteristics, and surrounding environment. Investigators seek answers to the following questions:

--Are hazardous substances present? Since all chemicals to some extent may be dangerous, depending on their concentration, it is important to first determine what hazardous wastes are present and in what concentration. This requires site sampling and analysis of samples.

--Has or will contamination of the environment occur? If hazardous wastes are present, the extent of contamination of the soil, surface water, groundwater, and air both onsite and offsite must be determined. This requires a definition of the pathways for migration from the site and the rate and concentration at which the wastes will migrate along those pathways.

--Is there a population that can be affected? Once hazardous wastes are found at a site and there are pathways for migration from the site, a determination of the likelihood of human exposure must be made. It is one of the most important characteristics for determining a site's hazard potential.

The manner in which these determinations are made forms the basis for an evaluation of the potential risk posed by a site to the public health or to the environment.

OBJECTIVE, SCOPE, AND METHODOLOGY

We were asked by the former Chairman of the House Subcommittee on Oversight and Investigations, Committee on Interstate and Foreign Commerce, Robert C. Eckhardt, and Congressman Albert Gore, Jr., to examine (1) the kind of scientific evidence necessary to determine whether or not a particular disposal site poses a significant hazard to public health and (2) the capacity to collect and substantiate the kind of evidence required (by governmental agencies and the courts) to prove the presence of a hazard or the presence of a relationship between a disposal site and impaired health.

To respond to these broad scientific and legal questions related to hazardous waste sites, it was agreed that the review work would focus on Government efforts in

--testing and sampling for hazardous wastes both at the disposal site and offsite,

--analyzing and interpreting test results,

--taking enforcement actions against sites posing a substantial and imminent endangerment to health or the environment, and

--proving in court that adverse health effects were caused by exposure to hazardous wastes.

To accomplish these overall review objectives, we concentrated on three hazardous waste areas: site investigation activities, research efforts, and enforcement and litigation issues. Most audit work was performed at EPA offices, but we did visit and discuss these same areas with a number of other Federal departments and agencies and outside groups.

During the review work, we did not attempt to perform technical analyses of the numerous sampling, testing, and analytical methods and techniques used in assessing the potential hazard posed by a hazardous waste. Instead, we relied on discussions with technical experts both within and outside EPA to form judgments on the usefulness and value of the methods and techniques being used and those planned.

Our audit work concentrated on those sites EPA has classified under its uncontrolled hazardous waste site program--an interim program to address the worst known problem sites, which has as its primary objective the elimination of the threats to public health and welfare and to ecologically sensitive areas. Excluded from our scope were sites specifically classified for nuclear and radioactive wastes, although such wastes have been found at uncontrolled sites.

At EPA headquarters in Washington, D.C., we interviewed various officials involved in the hazardous waste areas of site investigations, research, and enforcement to determine what activities were ongoing and planned. For example, we discussed site investigation activities with the Chief of the Hazardous Waste Site Control Branch, reviewed his files on numerous cases where damage had been caused by hazardous waste sites, and obtained copies of a May 1980 report, "Damages and Threats Caused by Hazardous Material Sites," which documents hundreds of examples, and a draft site-investigations manual.

Research topics, such as overall research strategies and state-of-the-art limits, were discussed with EPA headquarters officials, including the Cochairman of the Solid Waste Research Committee and the Assistant Director for Planning, Office of Health and Environmental Assessment. Research documents obtained included the April 1980 draft of the "Solid and Hazardous Waste Research Strategy" and numerous research output plans for guiding work at EPA's research laboratories.

Hazardous waste enforcement issues, such as evidence necessary for a court case, were discussed with members of EPA's

Hazardous Waste Enforcement Task Force, including the Director, Technical Director, and Legal Director. These officials provided documents, such as the monthly statistical survey summary from the Hazardous Waste Enforcement and Response System and a January 25, 1980, memorandum on the standard of proof for hazardous waste enforcement task force cases which may present an imminent and substantial endangerment to health or the environment.

We also visited nearly every major EPA research facility, including the Environmental Monitoring and Support, Municipal Environmental Research, and Health Effects Research Laboratories in Cincinnati, Ohio; the Environmental Criteria and Assessment Office in Cincinnati, Ohio; the Environmental Monitoring Systems Laboratory in Las Vegas, Nevada; the Robert S. Kerr Environmental Research Laboratory in Ada, Oklahoma; and the Environmental Monitoring Systems, Health Effects Research, and Environmental Sciences Research Laboratories in Research Triangle Park, North Carolina. The purpose of these visits was to discuss hazardous waste research efforts with EPA officials responsible for implementing overall research strategies and to gain a better understanding of research underway and planned and the state-of-the-art limits that exist in the hazardous waste area.

Interviews were held with numerous officials at each laboratory, including the laboratory directors and individual project managers. We discussed issues ranging from what hazardous waste research was ongoing and planned, to areas where more research was needed. Documents obtained during these meetings included, among others, research planning documents, the Proposed Work Plan for the Love Canal Monitoring Project, an Assessment of Health Risks Associated with Hazardous Dump Sites, Methods of Approximating Transport of Organic Pollutants to Groundwater, and a March 1979 report entitled "Analysis of Organic Air Pollutants by Gas Chromatography and Mass Spectroscopy."

We did not visit any of EPA's 10 regional offices to specifically evaluate how sites were identified or how they were investigated and evaluated. Such work would have been resource intensive and would not have materially affected the accomplishment of the review objectives. We did visit, however, EPA's National Enforcement Investigations Center (NEIC) in Denver, Colorado, whose staff has been involved in site investigations and evaluations, chemical analysis of samples taken at sites, and expert testimony in court cases. We discussed these issues with several officials, including the Director, the Assistant Director for Operations, the Chief of the Technical Evaluation Staff, and the Deputy Assistant Director for Laboratory Services. Many documents were also obtained during this visit. One example is the April 1980 draft entitled "Enforcement Considerations for Evaluations of Uncontrolled Hazardous Waste Disposal Sites by Contractors." In addition, we observed an ongoing EPA enforcement investigation conducted in the State of Michigan.

Research efforts and related hazardous waste topics were discussed with officials from other Federal departments and agencies and elsewhere, including the Department of Health and Human Services; Department of Justice; U.S. Geological Survey; National Bureau of Standards; Center for Disease Control; National Institute for Occupational Safety and Health; National Institute of Environmental Health Sciences; National Science Foundation; the Office of Science and Technology Policy (OSTP), Executive Office of the President; the Council on Environmental Quality; and two U.S. district court judges. Further, we discussed the issues with officials of the National Academy of Sciences, the Chemical Manufacturers Association, the Environmental Law Institute, the Institute on Man and Science, and the Environmental Defense Fund.

We interviewed various officials from these Federal departments and agencies and outside groups to gather additional information in several areas, such as health effects, groundwater studies, legal constraints in hazardous waste cases, and chemical analysis, and obtained documents related to our review objectives. For example, at the Department of Health and Human Services (HHS), the Senior Advisor for Environmental Affairs to the Assistant Secretary for Health provided us with a copy of an HHS report released in September 1980 entitled "Assessment of the Threat to Public Health Posed by Toxic Chemicals in the United States." At the Department of Justice, we discussed hazardous waste litigation issues with the Chief of the Hazardous Waste Section and obtained brief summaries of the hazardous waste enforcement cases that had been filed in Federal district courts.

We discussed the health studies planned for the Love Canal site in Niagara Falls, New York, with the Director of the Center for Disease Control's Chronic Diseases Division, Bureau of Epidemiology. At the Council on Environmental Quality we discussed the overall subject of hazardous waste with a Council member and the Senior Staff Member for Environmental Health and Toxic Substances and obtained a draft report, "Supplementary Strategies for Toxic Substances Control: Deterring and Compensating for Harm and Risk." Further, at the Office of Science and Technology Policy, we discussed OSTP's October 1979 report entitled "Scientific and Technical Needs for Hazardous Waste Management."

CHAPTER 2

SITE INVESTIGATION AND EVALUATION RESOURCES NEED TO BE EXAMINED

EPA has not investigated or evaluated thousands of potential hazardous waste sites to determine whether a hazard does or does not exist. As of December 31, 1980, EPA had identified 8,677 potential hazardous waste sites with more than 400 being added monthly. EPA had not performed even preliminary work at over 3,400 of these sites, let alone the work required to determine whether a hazard does or does not exist. Resources from the recent passage of the superfund legislation will help in this area, but EPA must determine what total resources are needed to perform site investigations and evaluations for the increasing number of hazardous waste sites.

HAZARDOUS WASTE SITES--THOUSANDS EXIST WITH HUNDREDS MORE BEING DISCOVERED EACH MONTH

EPA and the States have identified and are identifying thousands of potential hazardous waste disposal sites that require investigation and evaluation. Importantly, the number of sites identified was increasing at the alarming rate of over 400 per month. In November and December 1980, 456 and 405 sites, respectively, were identified.

EPA's estimates of hazardous waste sites have varied greatly in the last 2 years. For example, in November 1978 EPA estimated that nationwide there were 838 sites containing significant amounts of hazardous waste of which 103 were estimated to be potentially dangerous. Then, 3 months later in February 1979, an EPA-contracted study estimated that some 32,000 to 51,000 sites nationwide may contain hazardous waste and that from 1,200 to 2,000 of them could pose potential danger to health or the environment.

Since the February 1979 estimate, EPA and the States have started identifying and documenting the existence of potential hazardous waste sites. The following table shows, by various dates, the number of potential sites listed on EPA's regional logs.

Date	Number of potential sites
December 31, 1979	4,098
March 31, 1980	5,047
May 31, 1980	5,790
August 31, 1980	7,208
September 30, 1980	7,599
October 31, 1980	7,816
November 30, 1980	8,272
December 31, 1980	8,677

Although recognizing the existence of these sites, EPA has cautioned that each identified site had not been assessed to determine if a hazardous waste problem actually existed and that these sites should not be interpreted as a finding of illegal activity or confirmation that an actual health or environmental problem existed, only that the potential exists. As of December 31, 1980, however, EPA had determined that no action was needed at only 1,366 sites, or 16 percent of the 8,677 identified sites.

NEED TO DETERMINE RESOURCES REQUIRED TO COPE WITH INCREASING INVESTIGATION WORKLOAD

Since 1979 EPA has expanded its site investigation and evaluation efforts by developing a site investigation strategy and budgeting increased resources. These efforts, however, lag behind the ever-increasing number of sites requiring investigation and evaluation. The newness of EPA's uncontrolled hazardous waste site program is one contributing factor. Further, EPA simply does not know how many resources are required to perform the necessary site investigation and evaluation activities or how many sites need to be investigated.

The recent passage of the Comprehensive Environmental Response, Compensation, and Liability Act in December 1980 will provide EPA with an additional funding source for its site identification and investigation activities, but it is too early to determine whether these new resources will be enough. EPA planning for implementation of the act's provisions will, however, provide EPA with the opportunity to estimate total resource requirements to perform the needed site investigation and evaluation activities.

Site investigation strategy not developed until 1979

The investigation and evaluation of hazardous waste disposal sites only recently became a major issue for EPA. It was not until mid-1979 that EPA began to develop a strategy to address the problems posed by uncontrolled sites. Until that time, there was no coordinated, agencywide approach to the problem. EPA now

uses a phased approach for site investigations, oriented toward the evaluation of a large number of sites in a short time and with limited resources.

On May 24, 1979, the Deputy Administrator, EPA, announced the formation of a task force to complete a plan for an agency-wide hazardous waste site enforcement and response system. To her, it had become abundantly clear that EPA needed a more assertive response to hazardous waste disposal sites. According to the Deputy Administrator, EPA also needed

> "* * * to mount a concerted effort to identify potentially dangerous sites where hazardous materials have been dumped, to secure those sites against possible threats to public health and welfare or contamination of the environment, and to seek remedy of those sites by responsible parties, where such parties can be identified."

Then, in late June 1979, the Deputy Administrator announced acceptance of recommendations from the task force completing the plan for an agencywide hazardous waste site enforcement and response system. She added that "implementation of this Plan is of the highest priority." The plan's interim strategy was to respond to uncontrolled hazardous waste sites and the unacceptable disposal of hazardous wastes presenting public health and environmental risks which are presently known or which become known to EPA. The plan further provided that EPA

> "* * * does not contemplate an extensive systematic effort to discover new problems during this interim period: we already know more such problems than we can effectively deal with and more are being brought to our attention daily."

In November 1979 the Deputy Administrator changed the interim strategy by stating that although EPA still had serious resource problems, it clearly had to move into a more aggressive site-search role. There was a need to develop resource-efficient strategies that involve States, citizen groups, and contractors to the maximum extent possible. She added that it was not enough merely to identify potential sites. EPA's system must be designed to lead to the potentially most serious sites first. Furthermore, both EPA and the States must develop rational and defensible criteria for deciding which sites to investigate and respond to first.

While EPA was developing a strategy in 1979 to deal with the hazardous waste site problem, it also created new organizational components in headquarters to respond to and resolve the environmental and health problems resulting from uncontrolled hazardous waste sites. One component, the Hazardous Waste Site Control Branch, was assigned the responsibility for assessing uncontrolled

hazardous waste sites and providing technical assistance and resources for remedial action. EPA also created a Hazardous Waste Enforcement Task Force within its Office of Enforcement. It was assigned the responsibility to provide assistance to EPA regional offices in the preparation and filing of Federal enforcement actions to protect the public health and environment from uncontrolled hazardous waste sites. The National Enforcement Investigations Center provides the Task Force with special technical support required to carry out its mission.

How does EPA accomplish a hazardous waste site investigation?

EPA uses a phased approach for site investigations. Oriented toward the evaluation of a large number of sites in a short time and with limited resources, this management strategy segments investigations into three phases: (1) preliminary assessment, (2) inspection, and (3) field investigation. Each phase involves the collection of information which is reviewed, and then a decision is made on whether or not to proceed to the next phase. The overall investigation goal involves obtaining enough information in a short time and with limited resources to determine if a potential problem exists as a result of the materials at a site and the integrity of the site. Then, if a problem is found, its magnitude and the remedial action necessary are determined.

Preliminary assessment

After a site has been identified, collection of all the available background information is the first step in a site evaluation. In the context of EPA's phased approach, a preliminary assessment refers to the collection of data from available sources without actually visiting the site. Based on the information obtained, EPA determines that a hazard does not exist, an inspection is needed, emergency conditions exist, or enforcement action is appropriate. In the latter two instances, EPA would move quickly to take action. EPA will proceed to the next phase--inspection--to gather additional information if required.

Inspection

Inspections are critical since they involve an actual visit to the site to obtain first-hand information on the possible problem. The field work consists mostly of visual observations supported by some field monitoring for the presence of radioactive materials, explosive gases, and organic vapors. In most cases sampling will be limited except where direct human exposure to harmful materials (for example, via drinking water wells near the site) is expected. Usually an inspection will involve the efforts of three to five investigators for a period of no more than 2 days and is directed toward obtaining information on

--actual and potential pathways for hazardous material to migrate from the site and

--the population that can be affected or any environmental damage which could occur or has occurred.

As a result of the site inspection, EPA will determine either that a hazard does not exist, a field investigation is needed, an emergency condition exists, remedial action is required, or enforcement action is appropriate. Again, EPA would move quickly within available resources if either an emergency existed or enforcement action seemed appropriate. If additional data is needed, investigators proceed to the field investigation phase.

Field investigation

When the results of an inspection indicate that a particular disposal site poses a potential problem, then a field investigation is conducted to define the nature and scope of any environmental or health problems associated with the site. The investigation is resource intensive with emphasis on sampling of the areas believed contaminated at the site and laboratory analysis of samples to determine their makeup. Investigations differ from inspections primarily in the resources used and in the emphasis on sampling.

The sampling effort is the key to determining the nature of the problem. Based on the information obtained during the preliminary assessment and the inspection, various hypotheses are formulated regarding the site. The samples collected and their subsequent analysis are tests of these hypotheses. The resources allocated to investigate a site will depend on the objectives of the investigation, the nature of the site, the total resources available, and the location, number and kinds of samples to be gathered for analysis. Decisions on where to sample, what to sample, and number of samples required are based primarily on the judgment of the site investigators.

Investigation backlog increasing even though budgeted resources have been augmented

EPA's budgeted resources have not provided for the performance of needed site investigation and evaluation activities at thousands of sites. Even though additional unbudgeted positions have been devoted to these activities, the investigation backlog is increasing.

Until 1979 EPA had to divert resources from other activities to assist in the investigation and control of waste disposal sites potentially presenting a hazard. Then, in late 1979, as a result of a task force study on an "Agencywide Hazardous Waste Site Enforcement and Response System," EPA developed the uncontrolled hazardous waste site program. The major objectives of the program are to implement, manage, and coordinate the overall Federal

response to the uncontrolled hazardous waste site problem. The program strategy is threefold: (1) to identify and investigate sites (which will be performed primarily by contractor personnel), (2) to assess the degree of hazard at sites, and (3) to provide all possible support to EPA enforcement officials in developing and prosecuting cases against culpable persons.

Of the $ 7.1 million budgeted for the uncontrolled hazardous waste sites program in fiscal year 1980, over $16 million was to be spent on two contracts--a $7 million to $8 million field investigation contract and an $8 million to $9 million chemical analysis series of contracts. With these contracts the EPA budget projected that initial investigations would be performed on 500 sites, full investigations on 70 sites, support for enforcement cases against 35 sites, and analysis of 5,000 samples for organic and inorganic compounds and heavy metals. For fiscal year 1981 EPA estimated that both contracts would be continued at the fiscal year 1980 funding levels with results similar to those projected for fiscal year 1980.

The field investigation contract was signed on February 15, 1980, for about $9 million to cover work performed in fiscal year 1980 and part of fiscal year 1981. Actual contract expenditures during fiscal year 1980 totaled about $6.1 million. Investigation work completed by the contractor through early December 1980 consisted of 1,213 preliminary assessments, 547 onsite inspections, 86 full field inspections, and 19 remedial action concept plans.

A series of chemical analysis contracts for both organic and inorganic work were signed in fiscal year 1980. Under the organic analysis contracts, about $3 million was obligated during fiscal year 1980 with about $2.2 million yet to be obligated. Through the end of calendar year 1980, about 1,800 organic samples had been sent to laboratories for analysis. Regarding the inorganic analysis contracts, about $50,000 was obligated during fiscal year 1980 with about $60,000 yet to be obligated. Through the end of calendar year 1980, about 600 inorganic samples were sent to laboratories for analysis.

The Director of the Hazardous Waste Enforcement Task Force stated that budgeted resources had not been sufficient for the uncontrolled hazardous waste site program. For example, the hazardous waste enforcement activities were budgeted at the same levels for fiscal years 1980 and 1981. There were 53 total positions in the budget: 11 for the Hazardous Waste Enforcement Task Force, 5 for NLIC, and 37 for the regional offices. However, because this program was given a high priority within EPA, the Director stated that 22 additional unbudgeted positions were provided to the task force. He added that the regional offices had also provided unbudgeted positions for this effort. Based on a February 1980 task force analysis of the regional offices' actual workyear experience, about 172 workyears of effort were being devoted to the uncontrolled hazardous waste site program in fiscal year 1980.

The Hazardous Waste Enforcement Task Force Director also informed us that in the last days of the 96th Congress, a supplement to the fiscal year 1981 budget was approved to provide 20 headquarters positions and 19 regional office positions. He said that an additional 61 positions were requested, but a decision was made by the Office of Management and Budget to withhold them until plans were completed for implementation of the superfund legislation. These plans were being developed in December 1980.

At the end of December 1980, EPA had performed preliminary assessments on 5,247 sites, or 60 percent of the sites known to exist at that time. At the same time a final strategy determination--either no action was needed, remedial action was necessary, or an enforcement action should be filed--had been made for only 1,680 sites, or 19 percent of the known sites.

Based on the work completed during the last 2 months of the year, we believe EPA is having a difficult time responding to both the workload created each month by the more than 400 new sites being located and the large backlog already existing. For example, during those 2 months EPA added 861 sites to its logs but completed preliminary assessments on only 456 sites (53 percent of the discovery rate). Furthermore, during this period it completed final strategy determinations at only 25 percent of the discovery rate.

Superfund will help--
but how much?

The enactment of the Comprehensive Environmental Response, Compensation, and Liability Act (commonly referred to as "superfund") will provide increased funds for EPA's site investigation and evaluation activities. The questions are how much of an increase and when will the funds become available. The recent enactment of "superfund" makes these questions unanswerable at this time.

According to section 111(c)(3) of the act, the costs of a program to identify, investigate, and take enforcement and abatement action against releases of hazardous substances are provided for "subject to such amounts as are provided in appropriation Acts." The act also provides that within 180 days after enactment the President shall revise and republish the national contingency plan for the removal of oil and hazardous substances, originally prepared and published pursuant to section 311 of the Federal Water Pollution Control Act.

The plan's revision must include a section to be known as the national hazardous substance response plan. It is to include, among other things,

--methods for discovering and investigating facilities at which hazardous substances have been disposed of or otherwise come to be located;

--methods for evaluating, including analyses of relative cost, and remedying any releases or threats of releases from facilities which pose substantial danger to the public health or the environment;

--methods and criteria for determining the appropriate extent of removal, remedy, and other measures authorized by the act; and

--criteria for determing priorities among releases or threatened releases throughout the United States for the purpose of taking remedial action and, to the extent practicable, taking into account the potential urgency of such action, for the purpose of taking removal action.

Until this plan is published and resources identified to accomplish the required tasks, it is difficult to say how much the superfund will help EPA's uncontrolled hazardous waste site program.

CONCLUSIONS

Since 1979 EPA has increased its efforts and resources to investigate and evaluate hazardous waste sites. These efforts, however, have not enabled EPA to perform work at thousands of sites that must be investigated and evaluated. Over 3,400 sites existing at December 31, 1980, had not had preliminary assessments performed or final strategy determinations made.

EPA's fiscal year 1981 budget projected that funding would be sufficient to perform initial investigations on 500 sites and full investigations at 70 sites. At the end of 1980, EPA was identifying new potential hazardous waste sites at a rate of over 400 per month.

The recently enacted superfund will provide additional resources for site investigation and evaluation activities. Superfund planning activities should also provide EPA with the opportunity to estimate what total resources are needed to cope with the rapidly increasing number of potential sites that must be investigated and evaluated.

RECOMMENDATION TO THE ADMINISTRATOR, EPA

We recommend that the Administrator, EPA, as part of his planning to implement the superfund legislation and for use in future budgeting, provide an estimate of the total EPA resources needed to investigate and evaluate potential hazardous waste sites. The estimate should be based on those sites currently known to need investigation and evaluation and those that are projected to need such action in each of fiscal years 1981 through 1985.

AGENCY COMMENTS AND OUR EVALUATION

EPA stated that the report is generally accurate and presents the problem in an organized and well-documented manner. EPA believed, however, that the report may tend to overemphasize the late start EPA had in addressing abandoned hazardous waste sites, without giving adequate weight to the limited legislative authority available. EPA also believed that the report should have covered some of the more active State programs and some of EPA's efforts to aid and develop them. EPA added that this area of involvement will certainly grow rapidly along with the development of the superfund program.

We disagree with EPA's comment that this chapter tends to overemphasize the late start EPA had in addressing the hazardous waste site problem, without giving adequate weight to the limited legislative authority available. EPA's actions in 1979 and 1980 were quite different, as we point out in the report, yet EPA had the same legislative authority available to it during this period. We believe that the chapter presents a factual description of EPA's efforts which began in earnest during 1979. We also believe that the chapter accurately points out the actions taken since 1979 to confront the problem.

EPA also commented that the chapter should have covered some of the more active State programs and EPA's efforts to aid and develop them. We agree with EPA that States will play an important role in confronting the hazardous waste site problem, especially under the superfund legislation. This chapter, however, focuses on the overall problem and the status of EPA's uncontrolled hazardous waste site program.

Although EPA did not specifically state whether it agreed or disagreed with the chapter's recommendation, it did state that the report presents

> "* * * a balanced evaluation of a most difficult environmental problem. The conclusions that the problem is large, complex, resource intensive and not yet fully defined are true."

Our recommendation seeks to clearly define the magnitude of the problem by estimating the total resources needed to investigate and evaluate potential hazardous waste sites.

CHAPTER 3

ABILITY TO IDENTIFY HAZARDOUS WASTE AND ASSESS ITS HEALTH AND ENVIRONMENTAL RISKS IS LIMITED

Coping with the ever-increasing investigation workload is only one of the obstacles to be hurdled in EPA's attempts to assess the threats posed by hazardous waste sites. Once sites are identified, EPA then faces the difficult problem of determining the specific hazardous wastes present and their potential impact on health and the environment.

Unfortunately, EPA has only limited capabilities to quickly and inexpensively detect and identify the complex hazardous wastes mixtures found at disposal sites and very little understanding of the real or potential risk these wastes pose to human health and the environment. Much of EPA's problem is attributed to "state-of-the-art" limits; hazardous waste sites present some new and unique challenges for which a strong scientific data base is simply not available at this time. The complexity of co-disposed chemical mixtures, the wide variation of disposal site conditions, and the need to control for other environmental influences complicate EPA's ability to identify hazards and assess the relative risks of waste sites. Without such information, EPA's management of hazardous wastes and actions taken to prevent or control damage from improperly disposed wastes is less than optimal.

EPA is expanding its research and development efforts for hazardous waste, but increased research emphasis is needed in the areas of developing and standardizing methods for determining whether samples taken from potential hazardous waste sites are or are not hazardous, determining health effects caused by hazardous waste, and understanding the transport and fate of hazardous substances as they move in the environment.

Another agency, the Department of Health and Human Services, also plays an important role in many hazardous waste areas, including emergency response and research.

IDENTIFYING HAZARDOUS WASTES IS DIFFICULT AND COSTLY

Existing sampling and analytical methods for identifying hazardous wastes have not been standardized or validated. Furthermore, the methods in use are generally costly, complex, time consuming, and were developed for specific types of chemicals in specific media (for example, soils and sediments). The proper identification of hazardous wastes present at a site and its concentration is the first step in assessing the potential risk a site may pose. Problems arise, however, when dealing with the complex and heterogeneous waste mixtures and conditions found at hazardous waste dump sites. As a result, EPA finds it difficult to obtain representative samples that are

reproducible and comparable from site to site. In addition, chemical analysis is costly, and procedures may not be entirely suitable to the demands and needs created by hazardous waste site investigations.

Site investigators are adapting the existing sampling and analytical methods (what EPA terms "best available methods") coupled with their individual judgment to determine the scope and direction of investigation work. Investigators are faced with a number of trade-offs regarding where to best spend their scarce resources and how much effort to expend at any one site. These trade-offs could be lessened by developing biological tests, which evaluate the toxicity of sample materials, as tools for screening waste samples and onsite monitoring.

EPA recognized the importance of developing hazardous waste sampling and analytical methodologies in the April 1980 final draft of its Solid and Hazardous Waste Research Strategy which stated:

> "Sound sampling and analysis methodology is essential in all phases of hazardous waste management, including identification of specific hazardous wastes and their sources, monitoring of disposal operations, and cleanup of uncontrolled sites. * * * Standard analytical methods must be developed before a comprehensive program of chemical analysis can be initiated. No validated or standard methods for hazardous waste sampling and analysis are available, and there are only limited monitoring guidelines."

Standardized and validated sampling methods are needed to assure representative and reproducible results

EPA has not standardized or validated field methods which many EPA laboratory officials believe are essential to assuring that samples taken at disposal sites are representative and that results are reproducible and comparable from site to site. Another problem has been the difficulty in isolating background levels of pollutants that are not associated with the site under investigation. In the absence of such methods, according to EPA officials, site investigators must make individual judgments in determining how and where to physically obtain samples, how much material to collect, and how many samples are necessary.

The above are crucial issues affecting the accuracy of analytical and risk assessment efforts. If representative samples are not obtained, the true extent of a site's hazard and the risks posed to human health may not be known. Several EPA laboratory officials, including the Assistant Director, Environmental

Monitoring Systems Laboratory in Las Vegas, believed that site investigators' individual judgments have failed to ensure representative, reproducible, and accurate results.

EPA hazardous waste regulations define representative samples as those samples exhibiting the average composition and physical/chemical properties of the total disposed wastes or the media in which the waste is present (for example, water, air, soil, etc.). EPA is currently evaluating existing sampling methods for their applicability to the special problems of hazardous waste. Surface water sampling methods are generally considered more advanced than those for air, groundwater, and soils/sediments, but three EPA officials from the Quality Assurance Division of the Environmental Monitoring Systems Laboratory in Las Vegas questioned whether even these will yield representative results. EPA research documents indicate that selection of the best existing methods as the recommended standard sampling techniques will not be made before fiscal year 1983 at best; development of new methods will take even longer.

Another problem is obtaining the control samples necessary to screen out background interferences--that is, environmental levels of pollutants from sources other than the disposal site under investigation. Effective enforcement action depends on isolating the source of pollution, which in turn depends on controlling, or accounting for, other natural or industrial influences. For example, the highly industrialized environment surrounding Love Canal has made it difficult for EPA to determine the Canal's hazards apart from the general pollution level from factories and other disposal sites. According to EPA laboratory officials, including the Chief of the Quality Assurance Division and the Hazardous Waste Program Manager of the Environmental Monitoring and Support Laboratory in Cincinnati, and a senior biochemist from the Robert S. Kerr Environmental Research Laboratory, strategies for obtaining control samples are ill defined and vary with the individual site investigator. Control sampling, and sampling in general, are also hindered by limited knowledge of how wastes move through the environment.

Chemical analysis is a costly process with some problems

Existing chemical analysis procedures may not be entirely suitable to the new and difficult demands of hazardous wastes and to the needs of site investigations. Current procedures are generally expensive, time consuming, and require extensive laboratory work, sophisticated instrumentation, and highly trained personnel. It has also been difficult for EPA to adapt existing procedures to the new and complex problems of waste mixtures, heterogeneous site conditions, and multimedia samples. Although efforts to evaluate these procedures have been started, EPA estimated that it will be after fiscal year 1984 before they are expected to be fully available.

Several EPA laboratory officials, such as four officials from the Quality Assurance Division of the Environmental Monitoring Systems Laboratory in Las Vegas, believed that given adequate resource commitment, existing chemical analysis methods will identify with reasonable accuracy most of the compounds in a waste site sample, at least those hazardous wastes listed in the regulations and other targeted compounds. Costs to analyze hazardous waste site samples, however, can be quite expensive. For example, EPA budgeted $8 million to $9 million for chemical analysis contracts in each of fiscal years 1980 and 1981 to analyze 5,000 samples for organic and inorganic compounds and heavy metals. This is an average cost of $1,600 to $1,800 for each sample. EPA also estimated in NEIC's April 1980 draft entitled "Enforcement Considerations for Evaluations of Uncontrolled Hazardous Waste Disposal Sites by Contractors" that 10 onsite samples may be adequate to support a site investigation although additional samples may be required. Based on these assumptions, the chemical analysis cost would be $16,000 to $18,000 for each site where samples are taken. If a further assumption is made that one-fourth (2,169) of the 8,677 sites identified as of December 31, 1980, will require chemical analysis of site samples, the analytical costs alone could range from $34 million to $39 million vs. EPA's 2-year budget of $16 million to $18 million for such work.

In addition to high costs for chemical analysis, several EPA laboratory personnel, including the Director, Environmental Monitoring Division, and the Chief, Pollutant Analysis Branch of the Environmental Monitoring Systems Laboratory in Research Triangle Park, identified some analytical problems, particularly with nonaqueous samples. Some limitations they mentioned included difficulty in preserving samples at the concentration levels found onsite, problems in preparing samples for analysis, and complexities in identifying interference (masking) effects, where the presence of some compounds may be "hidden" from analysis by the presence of others. These officials and others believed, however, that most of the limitations could be mitigated, given sufficient resources.

The need to obtain quick results from a large number of heterogenous sites may necessitate trade-offs among available resources, analytical requirements, and investigation needs. These trade-offs will probably decrease analytical precision and reliability. For example, if only a few samples are taken at an individual site, identified compounds may not be representative of the entire disposed wastes. Furthermore, chemical analysis can only be as good as the sample taken. It cannot vouch for the representativeness of the samples or how they were taken.

EPA laboratories have begun efforts to evaluate existing analytical techniques used in other programs for adoption to hazardous waste problems. It is expected that "best available methods" manuals will be issued by fiscal year 1982 for

water, fiscal year 1983 for air, and fiscal year 1984 for other media. Standardizing and validating, developing new methods as needed, and full field use of approved analytical techniques are not likely to occur until after fiscal year 1984.

Although these methods must be pursued, it is also important given the high cost of chemical analysis to limit its use to the most urgent or pressing problem sites. Sites need to be screened to determine whether costly chemical analysis is required.

Biological tests may provide quick screening tools to reduce chemical analysis costs

EPA research documents, including the April 1980 draft of the Solid and Hazardous Waste Research Strategy, indicate that biological monitoring and bioassay techniques may be effective tools for screening waste samples and onsite monitoring of dump sites, thereby reducing the initial need for more costly and time-consuming chemical analysis. Biological tests use animals, plants, micro-organisms, and cells to evaluate the toxicity of sample materials. Biological analysis may also overcome some of the difficulties posed by mixtures and the synergistic/antagonistic 1/ reactions of co-disposed wastes since the tests study reactions to the whole waste stream and do not identify individual compounds in that stream. Biological tests may provide a rapid and inexpensive estimate of a dump's potential hazard.

EPA's interest in applying biological techniques to the hazardous waste situation is rather new with the result being that only a few biotests have been evaluated or validated. The AMES test 2/ for mutagenicity is probably the most well-known test. EPA initiated broad efforts to develop biological tests beginning in fiscal year 1980 and continuing at least through fiscal year 1984. According to the Director, Genetic Toxicology Division of EPA's Health Effects Research Laboratory in Research Triangle Park, and other laboratory officials, current and future methods need to be improved and made (1) sensitive enough to detect the very low levels and long-term effects of pollutants which are of so much concern to the human population and (2) applicable to a wider range of test organisms and types of biological effects.

1/Synergistic/antagonistic effects refer to how two or more compounds react with one another to create a greater or lesser hazardous waste stream, respectively.

2/A well-known, short-term test that measures a chemical's ability to cause mutations in a specially engineered strain of bacteria.

ASSESSING HEALTH AND ENVIRONMENTAL RISKS--AN AREA OF UNCERTAINTY

EPA's risk assessment activities have provided some limited information on the environmental damage caused by hazardous waste sites, but the true extent and nature of the threat to human health are virtually unknown. Current scientific knowledge, as demonstrated by the ongoing Love Canal studies, is critically deficient in several vital areas including determinations of how hazardous wastes move through the environment, how much of the wastes human populations are exposed to, and the degree of health hazard those amounts represent. Answers to these questions are crucial if EPA is to effectively identify a waste as hazardous, set site priorities for investigation on the basis of relative risks, and determine appropriate remedial actions.

There is general agreement within EPA, the Department of Health and Human Services, and the Office of Science and Technology Policy that assessing risk, particularly to human health, is the most serious deficiency in the Government's ability to handle the hazardous waste problem. OSTP concluded in its October 1979 report entitled "Scientific and Technical Needs for Hazardous Waste Management" that:

> "* * * Though some knowledge is available about the effects of pure chemicals, virtually nothing is known about the effects of chemical mixtures on health and the environment; the ways that wastes migrate through soils, ground and surface waters, and air; the likelihood of exposure to humans and to the ecosystem; and the susceptibility of specific population groups to various wastes."

Transport and fate of pollutants is difficult to predict

Little conclusive information is available concerning how chemical compounds leave disposal sites and what happens to them as they migrate through the environment to reach human populations. The Director of EPA's Environmental Sciences Research Laboratory in Research Triangle Park and several other laboratory officials stated that it is difficult to predict how fast pollutants may travel; if their chemical structures will be altered into more- or less-hazardous forms; whether they will pose a threat to humans or the environment; and how long the threat will last. There are several reasons, including

- --the large number of individual compounds, each with somewhat different migratory characteristics;
- --the complex synergistic/antagonistic interactions of compounds as they are mixed;

--the wide variations in dump site and environmental conditions, again causing a myriad of migratory possibilities; and

--largely unknown physical, chemical, and biological transformations that occur as pollutants change and are changed by natural processes as they move in the environment.

Several EPA laboratory officials, including the Director, Robert S. Kerr Environmental Research Laboratory, believed that these difficulties are particularly acute when hazardous wastes enter groundwater and the air. These officials added that research into groundwater and airborne movement of hazardous wastes had not been considered high priority until the recent realization that huge sections of the population may be exposed through these routes.

How wastes move through soils to groundwater and what happens to them along the way is not well understood; neither is groundwater movement nor its natural degradative actions. It is known that groundwater pollution has been the most frequently reported damage incident associated with waste disposal sites and that once groundwater is polluted, it may take decades or even centuries for the hazards to be naturally degraded.

The problems of airborne pollutants include being able to identify the very small concentration levels of toxics in the atmosphere and to isolate the effects of a particular disposal site from the general level of pollutants in the environment. This is particularly true in heavily industrialized areas where there may be many sources of pollutants, thus making it difficult for site investigators to determine specific sources of the pollution. Also, EPA studies, according to the Director, Environmental Monitoring Division and the Chief, Pollutant Analysis Branch of the Environmental Monitoring Systems Laboratory in Research Triangle Park, have found that some hazardous pollutants may travel hundreds of miles, affecting major population groups far from the disposal site.

Many EPA laboratory officials, including the Director, Quality Assurance Division of the Environmental Monitoring Systems Laboratory in Las Vegas, believed that inadequate data regarding transport and fate can severely constrain site investigations. Without such data the source of an identified hazard cannot be conclusively proven. An EPA hydrologist from the Groundwater Research Branch of the Robert S. Kerr Environmental Research Laboratory cited two investigations, one in Oklahoma and the other involving early work at Love Canal, where identified hazardous substances found in water wells could not be reliably tied to the suspected source because of inadequate information on pollutant pathways. Without such data, EPA has relied on assessments of the potential risks posed by a waste site. In

many instances, the courts are being asked to decide the merits of such potential risk assessments. This is discussed in more detail in chapter 4.

EPA is conducting some transport and fate studies, but these are largely limited to controlled laboratory experiments with little field confirmation. An EPA microbiologist believed that it will take up to 5 years to gain even a rudimentary understanding of transport and fate processes and many more years, if ever, before these processes are fully understood.

Health effects from exposure are virtually unknown

EPA's ability to quickly and accurately assess the health hazards of disposal sites is limited. A hazard assessment is based on the amount of pollutants a population is exposed to and the toxic effects on human health caused by such exposure. Both exposure and health effects research are fields of great scientific uncertainty. Numerous EPA laboratory officials, including the Directors of the Health Effects Research and the Environmental Monitoring Systems Laboratories in Research Triangle Park, believed that the problems involved in assessing health effects seriously constrain EPA's ability to manage hazardous wastes, make effective enforcement decisions, and take legal actions against polluters.

Of particular concern are the chronic health effects that may be caused by long-term exposure to low levels of hazardous wastes. Most exposures are believed to occur through the drinking of contaminated groundwater for long periods. The effects of this are unknown. While there is some capability to evaluate the acute (immediate) health effects from hazardous waste exposure, very little is known about chronic toxicity. Chronic damage may have a latency period of 10, 20, or more years between first exposure and the onset of measurable damage. Also, over 50,000 chemicals are currently in commercial production and most have not been tested for chronic toxicity. The information gap grows larger every year because research capacity cannot keep up with approximately 1,000 new chemicals entering the market place annually.

Exposure assessment

Assessing exposure is based on sampling and analytical data, information on environmental conditions, transport and fate analysis, and a determination of the populations at risk. All these components have limitations, as discussed earlier. When these individual shortcomings are added together, there is little confidence in the accuracy of the resulting estimate of total exposure. According to the Assistant Director, Exposure Assessment Division of the Environmental Monitoring Systems Laboratory in Las Vegas, rudimentary efforts are

underway to predict exposure levels through the use of mathematical models, but these currently yield only rough estimates of exposure, at best.

Toxicity assessment

There are three primary ways to evaluate the chronic effects of chemicals: human epidemiology studies, long-term animal studies, and short-term tests. Epidemiology and long-term animal studies are the only tests officially recognized by EPA as providing definitive, quantitative evidence that a chemical substance poses a health hazard to humans, but both have some shortcomings in dealing with the hazardous waste problem. Short-term tests, in EPA's opinion, may provide the type of inexpensive, rapid support needed for hazardous waste site investigations but do not presently provide definitive evidence of risk.

Epidemiology studies may not be useful to many hazardous waste enforcement actions because they are expensive, time-consuming, and complex. Most past studies have been done on specific pollutants, and it is difficult if not infeasible to conduct epidemiology studies on waste mixtures.

Epidemiology studies examine the health and exposure histories of specific population groups in an attempt to correlate disease patterns with exposure to a hazardous substance. A control population is used to account for environmental and social influences that may have contributed to health problems in addition to the hazardous substance of interest. Special problems exist in obtaining good historical health and exposure data, obtaining a representative control population, controlling for other influences, and the sheer effort involved in tracking large numbers of people. According to two officials from the Epidemiology Division of EPA's Health Effects Research Laboratory in Cincinnati and an official from the Epidemiology Branch of the Health Effects Research Laboratory in Research Triangle Park, these problems are compounded in hazardous waste cases because EPA is attempting to evaluate the effects from unknown mixtures or study large populations over long periods for often minute changes.

Long-term studies, where test animals are exposed to toxic agents, also may not meet EPA's needs for fast, inexpensive testing of unknown, complex mixtures. Such studies can cost several hundred thousands of dollars, take as long as 5 years to complete, and are commonly performed for only one suspect compound at a time. Moreover, the results must then be extrapolated in order to estimate potential human health risks. At this time, such extrapolation is inexact.

To overcome some of the problems associated with epidemiology and long-term tests, EPA has emphasized the development of short-term tests to detect a chemical's genotoxic potential, that is, its ability to alter a cell's genetic material. Evidence is

increasing that chronic diseases like cancer, birth defects, and genetic diseases may be initiated by changes in a cell's genetic material. Since the fundamental structure of this material is the same for all organisms, the effects of chemicals on test organisms or cells can theoretically have the same effect on humans. Short-term tests are also more rapid and less expensive, enabling a larger number of compounds to be screened than could be by long-term animal or epidemiology studies. However, EPA at this time considers short-term test results to be only suggestive evidence of a potential hazard.

Current short-term tests, moreover, are generally too specific in that they measure only one type of biological effect and are not sensitive enough to show the effects from very low levels of wastes. To mitigate the former problem, EPA is developing a phased testing strategy, which uses a number of different tests to measure a wide range of effects and determines if other more expensive and conclusive tests (like long-term bioassays) are necessary. Planned research will attempt to develop tests that are more generalizable --capable of producing wider ranges of responses--and more sensitive so that better estimates of the chronic effects from low exposure levels can be made.

Disagreement existed among EPA laboratory officials as to how limited health effects data constrains management and enforcement actions. Some, such as the Deputy Director of the Health Effects Research Laboratory in Cincinnati, believe that actual, measured effects must be proven to properly support actions while others, such as the Director, Neurotoxicology Division of the Health Effects Research Laboratory in Research Triangle Park, perceive that potential, suggestive evidence is sufficient. It is likely that the courts will have to decide this issue in light of the current scientific knowledge available on health effects.

Love Canal studies show the limits of scientific ability to link health effects with exposure

The limits of science are fairly well demonstrated in the ongoing work at the Love Canal hazardous waste disposal site in Niagara Falls, New York. This site has continually been cited as an example of the result of inadequate or improper disposal of hazardous wastes and has been the most studied and talked about site in the United States. It is also the site for which EPA and HHS' Center for Disease Control (CDC) have planned the most exhaustive environmental assessment and health studies contemplated to date.

Although $5 million is expected to be spent on the health studies, many officials, including the Senior Advisor for Environmental Affairs to the Assistant Secretary for Health, HHS, and the Director of EPA's Environmental Monitoring

Systems Laboratory in Research Triangle Park, do not believe that health effects experienced by Love Canal residents will be conclusively linked to chemicals found at the site. Two other HHS officials--CDC's Director, Chronic Diseases Division, Bureau of Epidemiology, and the Director, National Institute of Environmental Health Sciences--have been quite vocal about the inability of science to link the site's chemicals with health effects. They commented in the August 11, 1980, edition of Chemical and Engineering News on what can be scientifically said regarding the health effects at Love Canal. During interviews we held with these officials in September 1980, they reiterated the same statements made at that time. For example, CDC's Director, Chronic Diseases Division, Bureau of Epidemiology, stated:

> "* * * It is a difficult problem to say a low-level exposure to this or that chemical, let alone to these chemicals in combination, does or does not cause illness. * * * the concerns here deal with unknown and rare effects. That, plus the fact that we are dealing with chemicals acting in combinations that have never been tested, makes it difficult to predict even which effects should be looked for."

The Director, National Institute of Environmental Health Sciences, succinctly defined the scientific limits that exist today. He stated:

> "The important scientific problems at Love Canal are that little is known about the toxicity of the chemicals, and that it is difficult to use health surveys and epidemiological studies to associate exposure to chemicals from dump sites with human health effects. We do not have markers that help us associate disease with prior chemical exposure. Moreover, in a statistical sense, most dump areas impact on the health of relatively few people, and it is difficult to detect relatively rare events in small populations. Because we can't generalize about the toxic effects of multiple chemical exposure, it is almost impossible to estimate the health impacts of such exposure other than to assume that they are simply additive."

A detailed discussion of the Love Canal environmental assessment and health studies that were planned in August and September 1980 and the expected results is provided in appendix I.

LOW RESEARCH BUDGET AND PRIORITIES CONFLICT WITH ANNOUNCED NEEDS

Hazardous waste research and development efforts have historically been funded at minimal levels even though EPA now considers the problem to be of highest priority. Research previously emphasized nonhazardous waste problems, such as municipal

landfill design and resource recovery from solid wastes. Beginning with the fiscal year 1981 budget, EPA started to focus research on hazardous waste issues.

In early 1979 EPA declared that hazardous wastes and uncontrolled sites were problems of highest priority. However, research funding through fiscal year 1980 has not followed suit. Planned fiscal year 1981 funding was sizably increased over past years, but much of the increase was projected for developing methods to handle future wastes, not the problem of already disposed wastes.

Research into transport and fate and health effects are two areas recognized by EPA officials as requiring greater research emphasis. For example, the Director of the Robert S. Kerr Environmental Research Laboratory told us in August 1980 that overall, transport and fate research still receives lower priority than most other hazardous waste research and development categories. Furthermore, the Director of Program Operations of the Health Effects Research Laboratory in Cincinnati stated that health effects research had been historically underfunded and underemphasized, yet it is critical to effective regulatory actions. OSTP also recognized the problem in its October 1979 report by concluding that "relatively little funding has been provided for research to detemine how the effects of hazardous waste can best be ameliorated or eliminated."

The following table presents estimated research expenditures for hazardous waste from fiscal years 1978 through 1981. 1/

1/Estimates were made by the Cochairman of EPA's Solid Waste Research Committee.

Estimated Expenditures on All Types of Hazardous Waste Research

Research activity	Research expenditures FY 78	FY 79	FY 80	FY 81
	- - - - - (millions) - - - - -			
Sampling and analytical procedures	$0.1	$0.7	$0.7	$4.5
Toxicity assessment and health effects	0.2	0.2	0	3.0
Fate and transport	0.5	0.5	0.5	(a)
Technologies for clean-up of existing sites	0	0.5	0.8	3.2
Technologies for managing current and future wastes	2.4	3.4	3.4	14.4
Other expenditures	0	0	0	1.3
Total	$3.2	$5.3	$5.4	$26.4

(a)Included in the two "technology" activities.

According to the Director, Environmental Monitoring Systems Laboratory in Las Vegas, other EPA officials, and planning documents, there is significant research funding in other EPA programs, such as water quality, pesticides, and toxics, that have or could have applicability to hazardous waste problems. However, no estimates of the measurable impact of such benefits were available to quantify total research funding in the hazardous waste area.

DEPARTMENT OF HEALTH AND HUMAN SERVICES' ROLE IN HAZARDOUS WASTE ISSUES

Although much of its effort is directed at studying pure chemicals, HHS has begun some efforts to study the public health issues associated with hazardous waste dump sites. For example, it established a departmental Committee to Coordinate Environmental and Related Programs with a Subcommittee on the Potential Health Effects of Toxic Chemical Dumps, and some committees have been established to coordinate with other involved agencies, such as EPA.

HHS' overall policy governing response to a health problem or emergency is that it will take action if requested to do so by a State Governor or public health department. HHS resources can also be directed to an environmental emergency at the direction

of the Federal Emergency Management Agency. Such action could include hazardous waste dump site problems or emergency situations, such as the recent disaster created by Mount St. Helen's. Regarding dump sites, however, a top-level HHS official believed that more must be done to develop and elaborate on the specific elements governing HHS' formal and explicit hazardous waste dump site policy.

More than two dozen major Federal laws provide control over toxic substances. A 1979 study by the Toxic Substances Strategy Committee 1/ found that the Federal Government had spent nearly $1 billion--directly or indirectly--on toxic substances research. Although this review did not evaluate non-EPA research efforts, limited information was obtained on HHS' role in the hazardous waste issues. For example, HHS has major toxic substances research efforts underway, including for fiscal year 1980

--$125 million for toxicity testing,

--$114 million for basic toxicity research,

--$28 million for studying human epidemiology of chemically related diseases, and

--$23 million for methods development.

HHS summarized its efforts aimed at the toxic chemical threat to public health in a report to the Senate Subcommittee on Environmental Pollution, Committee on Environment and Public Works, that was released on September 11, 1980. The report stated that the

> "* * * critical task before us is to determine what chemicals need to be controlled and at what exposure levels. * * * we need to know not just the biologic action of these chemicals, but also the quantity produced and the extent to which people will be exposed to them. * * * there still is much key information that must be developed regarding chemicals and their toxicity."

The report concluded that:

> "While at this time it is impossible to determine the magnitude of the toxic chemical risk, it is clear that it is a major and growing public health problem. Efforts to define the magnitude of the problem more precisely are hampered by two factors: first, the

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1/The committee is chaired by the Council on Environmental Quality and includes representatives from all Federal departments and agencies with major policy, research, or regulatory responsibilities relating to the control of potentially hazardous chemicals.

long latent period that frequently exists between chemical exposure and chemically induced disease and, second, the newness of the science of environmental toxicology. Thus, as the problems of toxic chemical waste dumps and aquifer contamination have shown us, we are currently in the very early stages of a health problem which may take years to assess fully."

The report also outlined HHS' major programs and studies that affect these issues.

HHS has recognized that chemical waste dumps pose potential public health problems. In September 1979 the Secretary, HEW (now HHS), requested an exploration of policy issues regarding the substantial evidence that dumps of certain industrial chemical waste present a grave danger to public health, both through direct contact and via contamination of drinking water sources. A February 11, 1980, memorandum for the Secretary from the Deputy Under Secretary for Intergovernmental Affairs responded to this request.

The February 11 memorandum described the problem, the current Federal role, EPA's role, HEW's role, and interaction with States. It then presented three options and discussed the pros and cons of each and recommended one for the Secretary's approval. The options were to:

1. Continue the present, low-level approach.

2. Modestly expand and refocus the present research operation and make its product more available through cooperative activities with EPA.

3. Move more aggressively, requesting important expansions of resources, making major shifts in research focus, and develop in the Public Health Service the ability to investigate hazardous waste dumps that present clear human toxicity danger, assess that danger and, in cooperation with State and local authorities, arrange for medical diagnosis and the protection of human health.

The memorandum recommended that option 2 be approved and that a study be made of the costs and implications of the third option.

Although never formally adopting any of the three options, the Secretary, according to the Senior Advisor for Environmental Affairs to the Assistant Secretary for Health, decided to pursue the issues somewhere between options 2 and 3. For example, he said that the Secretary had recently reorganized CDC and created a new Center for Environmental Health under CDC's direction. Also, an executive committee to the departmental Committee to Coordinate Environmental and Related Programs was created to

advise the Secretary and the Surgeon General of the United States on development of policy, setting priorities, and implementation and management of those priorities and policies; a Public Health Service task force on emergency response will develop a guide for agency action in dealing with hazardous waste dumps; and this same task force will make recommendations for revising the national contingency plan required by the superfund legislation. Furthermore, during the summer of 1980, the Secretary, HHS, and the Administrator, EPA, met to discuss issues surrounding the hazardous waste problem.

Out of this meeting, HHS and EPA hope to develop an agreement which would establish a mechanism to facilitate coordination, particularly with respect to emergency response, research, training, and education. The Senior Advisor for Environmental Affairs elaborated on the issues by stating that HHS needs to be more definitive in its policy governing three areas: the dump site, research, and training. In his opinion, three specific issues need HHS attention:

--At the dump site, clarify the relationship of the parties involved, define the allocation of resources, and delineate Federal/State roles.

--Better coordinate research between EPA and HHS.

--Consider mechanisms for improved approaches to education and training.

Public Health Service officials reviewed a draft of this report and said that the report was a generally comprehensive and factual description of the current situation regarding hazardous waste sites. The officials believed, however, that the report did not make clear the distinction between making a determination under law of a "substantial and imminent endangerment to health" and making a determination of a valid relationship between human exposure to a hazardous substance and a disease or illness. In their opinion, this distinction clarifies the different responsibilities that EPA and HHS assume in the environmental area. They said that the lead responsibility for research programs in biological testing and health effects studies rests with HHS, not EPA.

Both agencies have research responsibilities in the hazardous waste area. EPA has recognized this concern in its fiscal year 1981 budget, which contains $3 million to document and determine the health risks associated with hazardous waste sites. The budget clearly states that EPA's research and development program on health effects "will be coordinated with other Federal agencies having more prominent roles."

CONCLUSIONS

The scientific data base is deficient in dealing with hazardous waste problems. Current sampling and analytical methods are not standardized or validated. Cost, timeliness, and expertise are important constraints limiting current methods' usefulness in responding to site investigation needs. The complexity of waste mixtures and the heterogeneity of dump sites also complicate EPA's ability to accurately and quickly identify disposed wastes. Biological tests may provide quick tools for screening waste samples, thereby reducing the initial need for more costly and time-consuming chemical analysis.

EPA's ability to assess the risks posed by hazardous waste dump sites is also deficient. Little is known concerning how far and how fast wastes may move from dump sites to affect the populace and how long wastes may persist in hazardous forms. Even less is known about the actual health effects caused by exposure to wastes, particularly chronic damage resulting from the low-level, long-term exposures believed to be widespread in the United States.

Without fairly quick, inexpensive methods to identify hazards and assess risks, it will become increasingly difficult for EPA to manage the problem. Setting priorities for site investigations, undertaking enforcement actions, and determining appropriate cleanup measures depend upon knowledge that the scientific community cannot sufficiently provide at this time. Research efforts, particularly the health effects and transport and fate areas, need increased emphasis to seek more timely solutions to the problems presented by hazardous wastes and hazardous waste sites.

HHS reported that it may take years to fully assess the health problems created by hazardous waste dumps. HHS plays an important role in dealing with many hazardous waste issues, such as emergency response and research. One top-level HHS official believed, however, that more must be done in three areas: the dump site, research, and training.

It is widely acknowledged that hazardous waste is one of today's most serious environmental problems. Given the current lack of scientific knowledge, the Federal Government must improve its ability to identify hazardous waste and assess its health and environmental risks.

RECOMMENDATIONS TO THE ADMINISTRATOR, EPA

We recommend that the Administrator, EPA, direct the Assistant Administrator for Research and Development to evaluate ongoing EPA hazardous waste research programs in the biolgical testing, health effects, and transport and fate areas to determine what actions can be taken to increase EPA's efforts to:

--Develop and standardize biological monitoring and bioassay techniques as methods for determining whether samples taken from potential hazardous waste sites are or are not hazardous, thus reducing the initial need for more costly and time-consuming chemical analysis.

--Better determine health effects, especially chronic effects, that are caused by or closely associated with exposure to hazardous waste.

--More accurately understand the transport and fate of hazardous substances as they leave disposal sites and migrate through the environment (soil, air, groundwater, and surface water) to reach human populations.

Further, the evaluation should specify where joint EPA/HHS research projects should be encouraged in these three areas.

AGENCY COMMENTS AND OUR EVALUATION

EPA did not clearly address the recommendations in this chapter. EPA appeared to disagree with the recommendations, on the one hand, by stating that the order of priorities determined by the report as suitable for research and development activities is not consistent with the order determined by EPA's internal management using the zero-based budgeting process. On the other hand, EPA's comments did show some agreement in the research areas. For example, EPA stated:

> "The report indicates quite properly that research to develop good biological testing methods should be substantially increased. The Agency would not, however, expect that biological screening tests will soon replace chemical testing, but rather that adequate biological screening procedures would allow the Agency to focus its limited chemical testing capability on the most pressing problem sites."

EPA also stated that "the report properly identified many of the scientific needs and problems which the Agency faces * * *."

We did not determine an order of priorities or suggest that EPA repudiate the results of its budgeting process, but we have clarified our wording to avoid this interpretation. We recommended and continue to believe that EPA needs to evaluate ongoing EPA programs in the biological testing, health effects, and transport and fate areas to determine where these efforts can be increased. We do not believe that EPA has adequately considered the merits of the research recommendations.

Although not directing any recommendations to HHS, we did request HHS comments on a draft of this report. HHS did not provide us with official comments; however, officials from its Public Health Service did provide us with unofficial comments on the draft report, as recognized on page 32.

CHAPTER 4

HOW WILL SUPERFUND AFFECT GOVERNMENT ENFORCEMENT EFFORTS AND SITE CLEANUP AND RESPONSE ACTIONS?

It is very difficult to legally prove actual exposure and resulting harm from hazardous waste given the scientific limitations discussed in chapter 3. Yet, on some occasions, both the Government and individuals must pursue these issues in the courts. For example, EPA is charged under various Federal statutes with taking action in the courts if evidence exists that a site presents an imminent and substantial endangerment to health or the environment. Under these statutes EPA and the Department of Justice, which prosecutes cases in Federal court for EPA, need only show evidence of potential harm to take disposers and generators of hazardous waste to court to force remedial action and site cleanup. The showing of potential harm as opposed to actual harm requires less evidence in court and also allows the Government to pursue more cases than it otherwise could with its limited resources.

The superfund legislation will help EPA take more timely and effective cleanup action at more sites than is now possible. EPA will be able to employ remedial measures or response actions first and then try later to recover through the courts the costs of such actions from responsible parties. In the past court cases were limited by available resources and financially viable defendants. Although a $1.6 billion revolving fund will be accumulated over the next 5 years, it is too early to determine whether the fund provides the resources needed to clean up or respond to all sites existing today and those that might be discovered later.

FEDERAL ENFORCEMENT EFFORTS HAVE BEEN LIMITED

Before the enactment of the superfund legislation, Federal enforcement efforts were limited by both the resources available to demonstrate potential harm in a case and by the need to identify financially viable defendants to pay for remedial measures or cleanup costs. Although the superfund will allow quicker cleanup action than before and pay for cleanup at sites having no financially viable owners, the Federal Government will still have to resort to the court system when seeking reimbursement for the fund from responsible parties. As in the past, EPA will use the emergency power provisions of several environmental laws to support its cases. Its interpretation of these laws is that potential harm is adequate basis for Government action. As of December 31, 1980, the Government had filed 55 enforcement actions, most of which were still in litigation at that time.

Endangerment statutes are the basis for action

EPA's basic premise for enforcement is that sites present an "imminent and substantial endangerment to health or the environment" and are in violation of existing regulations and constitute legal wrongs under common law theories such as nuisance and trespass. The "imminent and substantial endangerment" standard requires a showing of a risk of harm rather than actual harm. "Imminence" in hazardous waste cases, as the courts have accepted, applies to the nature of the threat.

Five Federal statutes have emergency response provisions authorizing EPA to take action if there is evidence of "imminent and substantial endangerment." The EPA Administrator, through the Department of Justice, can bring action for equitable relief on behalf of the United States in the appropriate Federal district court. The actions have included injunctive relief, cease and desist orders, and cleanup at the defendant's expense. The emergency provisions used most often are section 7003, RCRA; section 504, Clean Water Act; section 1431, Safe Drinking Water Act; section 303, Clean Air Act; and section 7, Toxic Substances Control Act. The facts of each case determine which of these provisions will be used.

EPA and the Department of Justice are using the authority provided under section 7003, RCRA, to pursue not only owner/operators of hazardous waste sites, but also transporters, generators, and producers.

Demonstrating potential harm is time consuming and resource intensive

EPA attempts to demonstrate "potential" harm with the minimum evidence possible, yet even providing this evidence has proven difficult because of scientific limits, discussed in the previous chapter, and resource requirements. The Chief of the Department of Justice's Hazardous Waste Section noted, "the burden of proof increases with the amount of relief requested." The Director, NEIC, stated that under normal circumstances 3 to 5 workyears could be expended on a case and that a difficult case could take up to 10 workyears of effort. Furthermore, the Director of the Hazardous Waste Enforcement Task Force estimated that an average of 6-1/2 workyears per case was spent on the 51 cases that were filed as of October 9, 1980.

To show potential harm, EPA's approach is to establish (1) the presence of hazardous chemicals on or near a site, (2) pathways for pollutants to leave the site and reach the environment, (3) the threat of fire or explosion, and/or (4) incompatible chemicals coexisting at a site.

The Department of Justice has filed 55 enforcement cases in U.S. Federal district court. As of December 31, 1980,

43 were in litigation, 4 sites have been cleaned up, and cleanup plans were being developed for the remaining 8 sites. Most cases filed have involved sites with high concentrations of chemical hazardous wastes rather than trace amounts. Relief requested has included (1) cleanup and remedial actions, including restoration of the environment, (2) fines, (3) provisions for alternative drinking water sources, (4) Federal reimbursement for remedial action, (5) restraining orders, and (6) further State action.

Once an enforcement action is decided upon, the resolution of a case can be quite lengthy and resource intensive. For example, one case filed by Justice in April 1979 was scheduled for trial in late February 1981--nearly 2 years after the case was filed. This time does not consider when EPA first started its site investigation. EPA also estimates it can support the filing of only 40 to 50 enforcement cases in fiscal year 1980. This is based on a budget of over $2 million (61 workyears) for salaries and expenses alone. As of December 31, 1980, EPA had 222 cases under investigation for potential enforcement action.

Considering that 8,677 sites had been identified as of December 31, 1980, it appears that EPA's enforcement program is only a partial answer to the waste site problem. In fact, EPA's fiscal year 1981 budget indicated that enforcement cases in 1980 will be taken against only those sites that pose the greatest imminent hazard to health and the environment.

Minimum possible evidence will be introduced to support enforcement cases

According to the Enforcement Task Force's Technical Director, limited resources available for enforcement dictate that the minimum possible evidence be introduced in court to support cases. This evidence will consist of limited sampling and analytical work in conjunction with other "suggestive" evidence such as toxicological data. For example, a case theoretically could be based on two samples, one to show presence of a hazardous chemical and another to show risk of harm by migration. He added that EPA believes it could pursue a case and win it based solely on the presence of one hazardous chemical found in more than trace amounts. The Technical Director noted, however, that at least one carcinogen had been found at each site where an enforcement case has been filed, and chemical concentrations have all been much higher than trace levels. He was also careful to point out that substantial evidence is still required to sustain "risk of harm" arguments. Although even limited sampling and analytical work is complex and costly, it is believed to be sufficient for enforcement requirements to prove potential harm or threats. The Chief of Justice's Hazardous Waste Section stated that if the Government had to prove actual damages, it could not prosecute more than five cases a year.

EPA plans to use limited health effects and toxicological data as secondary "suggestive" evidence. Using information from existing literature, any previous animal studies, and established benchmark levels, EPA will attempt to demonstrate the potential health effects associated with identified chemicals. EPA tries to avoid its own health effects testing at sites because such tests are costly, time consuming, and do not produce definitive proof linking effects to the site's contents.

The work required to support an enforcement case is substantial, and EPA's actions are designed to prove only that a site potentially threatens public health or the environment. EPA will not base a case solely on health damages because it recognizes the limits of scientific knowledge (as described in ch. 3) in legally linking exposure with health effects. Yet, an individual alleging health damages from hazardous waste must do just this: prove exposure to the waste and link the damages to wastes from a particular site. This formidable task is discussed in chapter 5.

SUPERFUND LEGISLATION WILL PROVIDE SOME RELIEF

Superfund legislation gives EPA strengthened authority and increased resources to more quickly clean up some of the increasing number of hazardous waste sites requiring action. It is too early to determine, however, how many sites can be cleaned up over the next 5 years because of several factors, such as tremendously varying costs of cleanup for individual sites and how often the fund will be replenished by responsible parties.

Major provisions of legislation

The major provisions of the legislation are:

--Chemical spills on land or water, both navigable and groundwater, are covered, but not oil spills.

--Owners and operators of waste disposal sites, those who produce hazardous wastes, and those who transport it will be liable for all cleanup costs and for up to $50 million for damages to natural resources owned or controlled by State or Federal Governments.

--A $1.6 billion fund over 5 years is established by a tax on petroleum and certain chemicals to provide 86-1/4 percent of the fund with the remaining 13-3/4 percent provided by Federal appropriations.

--A postclosure liability fund is established to provide $200 million to monitor legal dumps and make sure they cause no damage once they are closed.

--A new agency within the Public Health Service to be known as the Agency for Toxic Substances and Disease Registry will allow studies of health effects and registration of toxic waste victims.

--Reports and studies are required for a number of areas, including experience with implementation of legislation and the adequacy of common law and statutory remedies in providing legal redress for harm caused by the release of hazardous substances.

--The major responsibility for implementing the legislation rests with the President. The primary agencies that the President has delegated responsibility for carrying out the functions are (1) EPA to manage the fund and implement response and remedial action associated with hazardous sites, (2) EPA and the Coast Guard to maintain present distribution of responsibility for hazardous substance spills, and (3) Treasury Department to collect the taxes and enforce the tax structure.

The act does not provide, however, that injured persons may receive compensation from the fund. They must still seek relief in the courts.

EPA will be able to clean up more sites--the question is how many more

The funds available under the superfund legislation will provide EPA with ready resources to respond to and clean up a number of hazardous waste sites that would not have been possible before. Given the resources available, however, EPA will be able to respond only to the most urgent or pressing problem sites.

For example, section 105(8)(B) of the act provides

> "* * * To the extent practicable, at least four hundred of the highest priority facilities shall be designated individually and shall be referred to as the 'top priority among known response targets,' and, to the extent practicable, shall include among the one hundred highest priority facilities at least one such facility from each State * * *."

Funding available under the act to pay for cleanup or response actions is limited in any year to funds collected and appropriated. Based on a $1.6 billion fund for 5 years, $320 million will be available for expenditures each year. The exact percentage of this amount available to EPA to take cleanup action at hazardous waste sites is not determinable at this time. For purposes of discussion, however, an assumption is made that 85 percent, or $272 million, will be available.

How much cleanup will $272 million provide? Not much, if some of the current sites are used as a guideline. While all sites are obviously not going to cost as much as the Love Canal site, they can be quite expensive, as indicated below. For example, in its September 27, 1979, report on "Hazardous Waste Disposal," the Subcommittee on Oversight and Investigations, House Committee on Interstate and Foreign Commerce, offered the following examples of cleanup costs.

--Love Canal, New York: Cleanup costs to date have exceeded $27 million.

--Montague, Michigan: The State testified that cleanup may cost $100 million.

--Elizabeth, New Jersey: The State estimated that it will cost $10 million to safely analyze and dispose of the materials stored there.

--Central Florida: Studies required to ascertain the danger of phosphate slag dumping have cost the Federal and State governments almost $1.4 million. EPA estimates that cleanup work will range between $1.2 million and $2.9 million. EPA has since stated that this estimate is closer to the cost of cleaning up one site than to cleaning up the generic problem.

OSTP in its October 1979 report, "Scientific and Technical Needs for Hazardous Waste Management," provides even higher estimates for total cleanup costs. According to the report, cleanup costs, using currently available approaches, have been conservatively estimated to range from $4 billion to over $50 billion.

In some instances EPA will be able to recover the fund's cleanup costs from responsible parties. In others, the fund will be forced to absorb the costs when the responsible party is either unknown; cannot be located, cannot afford the cleanup costs, or declares bankruptcy and walks away from the site; or the responsible company was dissolved long ago. We believe superfund will enable EPA to clean up a number of sites, but the question remains--how many, given the high cost of cleanup?

Legislation requires report on implementation experience

Under section 301 of the act, many reports and studies are required. One which has a direct impact on issues discussed in this chapter is experience with implementation of the act. This section provides that within 4 years of the act's enactment, a comprehensive report on experience with implementation is required. Among the items that must be discussed in this report are

--the extent to which the act and fund are effective in enabling the Government to respond to and mitigate the effects of releases of hazardous substances;

--a projection of any future funding needs remaining after the expiration of authority to collect taxes, and of the threat to public health, welfare, and the environment posed by the projected releases which create any such needs; and

--the record and experience of the fund in recovering fund disbursements from liable parties.

This report will be invaluable to the future direction of the Government's efforts to cope with the problems posed by hazardous wastes and hazardous waste sites. However, we believe some initial assessments should be made before 4 years have passed. Two important areas that should be studied as part of the initial planning to implement the superfund legislation are (1) a current estimate of the resources needed to clean up and respond to hazardous waste sites, given the sites known to need attention today and those projected to need action in the future, and (2) ways in which the Federal Government can expand its enforcement efforts at uncontrolled hazardous waste sites.

By examining these two areas as part of the initial implementation planning, EPA can provide the Congress with current information on whether the fund's resources appear adequate to confront the problems known to exist and those that are projected and whether enforcement efforts can be expanded. Such information can aid the Congress in its future deliberations concerning this important piece of legislation.

CONCLUSIONS

Although EPA's enforcement activities are attempting to force companies to clean up hazardous waste sites, this is only a partial solution. By showing "potential" harm, EPA decreases time and money for litigation, though substantial evidence is still required to sustain risk or harm arguments, and may obtain some timely relief by settling out of court. However, with current resource levels, EPA estimated that only 40 to 50 enforcement actions a year could be filed, while the number of sites with enforcement potential is ever increasing.

The superfund legislation will aid EPA in taking more timely and effective cleanup action at more sites than is now possible. Although the legislation provides $1.6 billion over the next 5 years, it is difficult to say how many sites can be acted upon because of varying factors, such as costs of cleanup at individual sites and how often payments from the fund will be reimbursed from responsible parties. If EPA is forced to go to court for

this reimbursement, past experience has shown that court cases have been limited by both the resources needed to pursue cases and the time it takes to ultimately resolve them.

RECOMMENDATION TO THE ADMINISTRATOR, EPA

We recommend that the Administrator, EPA, as part of his planning to implement the superfund legislation and for use in future budgeting, provide an estimate of the amount of resources needed to clean up and respond to hazardous waste sites. Such amount should be based on those sites currently known to need cleanup or response action, those that are projected to need such action in each of fiscal years 1981 through 1985, and estimates of the fund's replenishment through responsible parties.

We also recommend that the Administrator assess how the Federal Government can expand its enforcement efforts at uncontrolled hazardous waste sites. If additional resources or increased legislative authority are among the alternatives, the Administrator should provide such information to the Congress for its consideration.

AGENCY COMMENTS AND OUR EVALUATION

EPA agreed that it has a mandate to protect the public from hazardous wastes, but the mandate, derived from RCPA, is primarily concerned with regulation of future hazardous waste practices. EPA added that the foremost mandate to remedy abandoned hazardous waste sites is derived from the recently enacted superfund legislation. EPA believed that the report correctly illustrates the magnitude of the problem, but should not be interpreted to suggest that funding may be sufficient. EPA concluded by stating that it did not predict that $1.6 billion will be enough to make more than a reasonable start on the problem. EPA did not address the recommendations in this chapter.

We do not agree that the report gives the impression that the $1.6 billion available under the superfund legislation may be sufficient to confront the abandoned hazardous waste site problem. The report specifically states that the superfund legislation will aid EPA in taking more timely and effective cleanup action at more sites than is now possible, but it is difficult to say how many sites can be acted upon because of varying factors, such as costs of cleanup at individual sites and how often payments from the fund will be reimbursed from responsible parties.

Although EPA did not specifically state whether it agreed or disagreed with the chapter's recommendations, it did state that the report presents

> "* * * a balanced evaluation of a most difficult environmental problem. The conclusions that the problem is large, complex, resource intensive and not yet fully defined are true."

Our recommendations seek to clearly define the magnitude of the problem by estimating the total resources needed to clean up and respond to hazardous waste sites and assessing how the Federal Government can expand its enforcement efforts at uncontrolled hazardous waste sites.

CHAPTER 5

COURTS PROVIDE LITTLE RELIEF FOR INDIVIDUALS SEEKING COMPENSATION FOR HARM

Individuals pursuing compensation in court for damages allegedly caused by exposure to hazardous wastes from disposal sites have found little relief from the legal system. They must rely on common law principles of demonstrating actual harm, which has proven scientifically demanding and nearly impossible for chronic, long-term injuries. Even though various alternatives for victim compensation have been proposed by Members of Congress and suggested by others, none have been adopted. The question of what to do for individuals allegedly harmed by hazardous waste is being examined, but there are few easy answers.

BURDEN OF PROOF IS GREAT UNDER COMMON LAW

Federal statutes provide little relief for individuals seeking personal harm compensation in hazardous waste cases. Such cases are generally pursued under common law. The burden of proof under common law is difficult to overcome.

Under common law, an individual can pursue a compensation case using several theories, including intentional harm, negligence, public nuisance, strict liability for "ultrahazardous" activities, trespass, and private nuisance. Which theory or theories to pursue must be decided on an individual basis, for no one theory neatly fits all hazardous waste cases.

Regardless of the common law theory applied, the plaintiff usually must show the existence of some pollution or hazard, the defendant's responsibility for it, and that it caused the alleged damage or injury. Thus, various stages of proof are required for a plaintiff to show damage was caused by a defendant, including

--locating the source of pollution,

--identifying the defendant(s),

--establishing and quantifying the presence of hazardous substances at the source, and

--defining the route or showing migration from the source to the individual's property.

Proving these items can be difficult because of extensive site sampling, chemical analysis, and expert testimony that may be required. The lack of owner/operator records can further complicate these issues.

Even though these steps may be adequate to award some relief for property damages, to receive compensation for health effects the plaintiff has to go one step further: prove exposure to the substance and the resulting injury. This means showing the cause/effect relationship between the pollution and the injury. Establishing this "link" may be easier for acute effects or if single chemicals are involved. However, it is virtually impossible for long-term, chronic effects that take years or decades to develop, such as cancer, or for mixtures of chemicals with unknown synergistic effects. Also, health effects alleged to have been caused through exposure may vary from one person to the next.

Showing health effects from hazardous waste requires expensive and lengthy animal bioassays, and even then results are inconclusive and pose problems in extrapolating them to the human population. Science (as shown in ch. 3) is still in the developmental stages for health effects. Courts may be asked to evaluate testimony from "experts" such as toxicologists and epidemiologists as the major evidence of health damages in a civil suit. Defendants are expected to counter these "experts," studies, and tests with their own evidence. If the defendant can show inconsistencies or conflicts in the evidence, it is difficult to say how the courts will rule. Whatever the situation, the burden of proof has not proven easy in cases of personal injury.

LITIGATION DIFFICULTIES DISCOURAGE INDIVIDUALS

Many legal and scientific sources have recognized the difficulties in litigating health damages in hazardous waste cases. For example, a June 1977 article in the Harvard Journal on Legislation described th problem in this manner.

> "Producing the evidentiary showing required to sustain the substantive proof of legal causation is an undertaking of no small magnitude. Logically, to prove causation, the plaintiff must be able to (1) isolate the harm-causing substance, (2) trace its pathway of dispersal from the polluter to the victim, and (3) show the etiology of the harm-causing substance. Without extensive scientific data these elements of causation cannot be firmly established. But introducing scientific studies - especially a full scale epidemiological study - does not guarantee success in proving causation. * * * courts may put to one side complex, technical scientific data and assumptions about the formation of mixtures, the synergistic effects of pollutants, the problem of joint polluters or the proof of causation itself. This refusal to consider scientific issues is especially likely when the experts disagree."

Other sources have stated that it is scientifically difficult to prove a cause/effect link between health damages and a substance to the degree necessary in a court of law. "Such relationships are a rare phenomenon," according to a former President of the American Public Health Association, and usually occur only for acute effects. The Congressional Research Service, in its June 1980 report on compensation for toxic substances pollution, concluded that

> "* * * plaintiffs in toxic pollution suits may have substantial difficulty in proving that a particular exposure to a pollutant was the cause in fact of an injury. * * * such problems of proof can be significant barriers to recovery, both in current litigation and in litigation that may arise upon the manifestation of any latent health effects."

These same sentiments have been echoed in publications of the American Bar Foundation and the Association of Trial Lawyers of America. They have urged courts to begin accepting scientific proof, such as epidemiological studies and statistical evidence, to show the presumption of causation, but they agree the courts face difficult decisions in these cases.

Faced with this tremendous burden of proof, individuals may be discouraged from pursuing legal relief for health damages from hazardous waste. The likelihood of adequate relief is dim because such litigation may take years; providing the scientific/technical evidence is expensive; civil procedures cannot provide immediate relief; delays may lead to inadequate out-of-court settlements; total damages may be greater than the polluter's ability to pay; workmen's compensation laws cannot apply since there is no clearcut cause/effect link; some injuries may take decades to manifest themselves; and State laws may apply a statute of limitation which would put a time limit on liability.

PBB cases in Michigan--an example

The problems identified in the previous sections are illustrated quite well by recent cases in the State of Michigan involving polybrominated biphenyl (PBB) contamination. PBB is a fire-retardant chemical related to the chemical PCB (polychlorinated biphenyl), whose manufacture was banned in 1976 by the Congress. In 1973, several 50-pound bags of a fire-retardant compound containing PBB were mixed with feed grain and eaten by Michigan livestock. As a result thousands of farm animals had to be destroyed or quarantined. One farmer filed a suit, Tacoma v. Michigan Chem. Co., to recover for damage to his livestock by low-level exposure to PBB. The case lasted 14 months, the longest in State history. It consumed 25,000 pages of court transcript, included 7,000 pages of exhibits, required 63 expert witnesses, and took the Judge 6 months and 155 pages in which to decide the case. The costs, including attorneys'

fees, have been calculated in the hundreds of thousands of dollars.

In the end, the farmer lost his case. The court ruled that the plaintiff had not sustained his burden of proving that the cattle had been damaged as a result of eating contaminated feed grain. The court ruling sent a shock wave of incredulity through the Michigan farm community. No appeal was filed.

The ruling also had a significant impact on the approximately 83 other lawsuits filed in Michigan arising from the PBB contamination. Almost all have now been settled out of court. These individuals cannot be faulted for obtaining a present-sum, certain payment without having to face the rigors and uncertainties of the courtroom.

VARIOUS ALTERNATIVES HAVE BEEN CONSIDERED AND OTHERS ARE BEING STUDIED

Various alternatives for victim compensation have been proposed by Members of Congress and suggested by others, but none have been adopted. Other studies, however, are either underway or planned to further examine the issue of what to do for individuals seeking personal harm compensation in hazardous waste cases.

Individuals must still rely on the common law system for relief even though many alternatives have been considered. Some of the proposed alternatives that were considered in the past are mentioned below.

1. Administrative Compensation. H.R. 5074, introduced in the 96th Congress, would establish administrative procedures for awarding uniform, adequate, prompt, and equitable compensation for victims of toxic substances. The bill adopts the "polluter-pays" principle, imposing a tax on manufacturers, processors, and distributors, based on a product's risk to public health, to serve as an incentive for industry to self-regulate.

   The proposal would also establish two independent administrative agencies to award compensation. The Administrative Board for Compensation would handle claims, hear evidence, and decide on the award, and the Office of the Ombudsman would ensure that the system operates equitably and efficiently.

   The bill would adopt a new system for showing causation that lessens the plaintiff's burden. Initially, the plaintiff must show "reasonable proof" of the pathway from source to victim and the resulting etiology of the damages. The board then sets up five "rebuttable presumptions," which the defendant must reasonably disprove to negate liability.

The proposal would lessen an individual's burden of proof, accept scientific and technical evidence, allow the board to delay cases to gather necessary studies or data, and allow for the collection of information on links between hazardous waste and health effects.

2. Toxic Tort Acts. Two proposals introduced in the 96th Congress, H.R. 1049 and H.R. 3797, would incorporate an administrative compensation system. Both create a new Federal cause of action in order to receive compensation and leave it up to new, independent offices within EPA to decide on the "link" between injuries and hazardous waste. Once EPA has decided the cause/effect relationships, individuals can use this in court to pursue compensation under the act's provisions. The bills also provide for a fund to deal with waste sites, and emergency assistance.

3. Loans and Grants. A few proposals were made in the 94th and 95th Congresses that would adopt a Federal loan or grant program, either to help compensate alleged victims during lengthy litigations, or to compensate for agricultural losses related to toxic chemical contamination. Any Federal aid could perhaps be recovered later through legal action.

4. Hazardous Substance Liability Fund. S. 2083, introduced in the 95th Congress, proposed such a fund, although there was no further action on it. It provided a liability-related fund for immediate cleanup and some victim compensation. The definition of a hazard was limited, however, since the bill would have applied only to water pollution and only to substances designated by EPA as hazardous within the meaning of section 311 of the Clean Water Act.

5. Insurance. Proposals to adjust State workmen's compensation mechanisms to handle hazardous waste victims have also been made and suggested both in and outside of the Congress. Then, injuries would not have to be adjudicated under common law, and liability and causation would not be vital factors in a case. Such a system is limited, however, because victims may have to be employees. The present system relies on limited State funds. It provides no disincentives for industry. Hazardous waste damages usually do not have such a simple cause/effect link as job-related injuries. A common complaint is that experience with the existing system has shown compensation is usually inadequate.

   Some type of first-party or product-liability insurance could be refined for hazardous waste damages. These may only provide limited coverage, and victims rather than the polluter would eventually pay.

6. Fine Tune Existing Systems. A Council on Environmental Quality official suggested that existing systems be altered to handle compensation rather than create cumbersome new mechanisms. Suggested systems included social security, State tort law, national health insurance, or target taxes on products.

To date, none of these alternatives have become reality. They have been debated in the Congress and elsewhere, yet individuals must continue to rely on the common law system for relief.

NSF study examining issues

The National Science Foundation (NSF) awarded a $91,000 grant in January 1980 to the Institute on Man and Science for a project entitled "Pollution-Induced Disease: An Assessment of Scientific Knowledge Concerning the Victim Compensation Issue." This 18-month effort is expected to help disclose how available, reliable, and useful scientific knowledge about the etiology of pollution-induced diseases is to the development and implementation of victim compensation programs. The project is exploring

--the present ability to significantly correlate chemical exposure to disease induction,

--the factors which tend to disallow direct identification of exposure/disease relationships,

--the methods to guide future attempts to identify and predict which newly synthesized chemicals may be hazardous to human health,

--the feasibility of establishing an index of toxicological systems and diseases to aid differential diagnosis of disease that is of toxicological origin to support a program of compensation, and

--the public policy implications of a Federal program designed to assist victims of exposure to toxic substances.

Superfund requires study of common law and statutory remedies

Although the superfund legislation does not provide for compensation to persons injured by hazardous waste, it does require under section 301(e) that within 12 months of the act's enactment a study be submitted to the Congress that determines the adequacy of existing common law and statutory remedies in providing legal redress for harm to man and the environment caused by the release of hazardous substances into the environment. When the report is submitted to the Congress, recommendations must explicitly address

--the need for revisions in existing statutory or common law and

--whether such revisions should take the form of Federal statutes or the development of a model code which is recommended for adoption by the States.

CONCLUSIONS

Many believe that those whose health has been injured by hazardous waste do not have an adequate remedy in common law. The burden of proof to establish the link between hazardous waste and health injuries is expensive and time consuming for individuals. To compound this, it is scientifically difficult to prove whether exposure to hazardous waste mixtures caused an individual's adverse health effects, especially long-term chronic injuries. Given such a scenario, alleged victims often are either discouraged from pursuing legal suits for compensation, or settle out of court.

Various compensation alternatives have been proposed by Members of Congress and suggested by interested parties. There are pros and cons for each alternative, with none appearing to provide the final solution. An NSF grant to the Institute on Man and Science is exploring the public policy implications of a Federal program designed to assist victims of exposure to toxic substances. The superfund legislation also requires that a study be performed on the adequacy of existing common law and statutory remedies. We believe that this study and the results of the ongoing NSF project should provide the Congress with the needed information to consider whether alternative solutions can address the problems an individual now faces when pursuing compensation through the court system.

AGENCY COMMENTS AND OUR EVALUATION

EPA did not address any of its comments to matters specifically discussed in this chapter. Similarly, NSF stated that it had no objections or comments on matters discussed in this chapter.

LOVE CANAL--PLANNED ENVIRONMENTAL ASSESSMENT AND HEALTH STUDIES

The Love Canal hazardous waste disposal site in Niagara Falls, New York, was declared a national disaster by President Carter in August 1978. It has continually been cited as an example of the result of inadequate or improper disposal of hazardous wastes and has been the most studied and talked about site in the United States. National attention on the problems posed by hazardous waste dump sites resulted from press exposure on Love Canal. EPA and the Department of Justice have filed suit against the site's former owner to compel its cleanup, eliminate health and environmental risks, and finance any necessary resident relocation. It is also the site for which EPA and HHS' Center for Disease Control have planned the most exhaustive environmental assessment and health studies contemplated to date. Because of the difficulties in linking health effects with exposure from hazardous wastes (mentioned in chs. 3, 4, and 5 of this report); the cost of the studies, estimated to be more than $10 million; and the reasons cited above, we believe a discussion of the Love Canal studies will illustrate what science can do today at a site.

Late in the 19th century an entrepreneur named William Love began construction of a canal around the Niagara Falls to produce power for industrial development. The plan failed, and only part of the so-called Love Canal was dug. This 16-acre ditch was subsequently used for chemical waste dumping between 1923 and 1953. In 1953, when the canal was completely filled with waste material, it was sealed with a clay cap and sold to the city of Niagara Falls. Thereafter, the area was developed for residential use, and an elementary school was built on the old canal site.

By the mid-1970s it became apparent that the clay cap had been broken, allowing rainwater and melting snow to overflow the canal, forcing chemicals to the surface of the canal and causing chemical seepage through surrounding soil into basements of nearby homes. In the summer of 1978, this growing problem of community chemical contamination led to action by State and Federal authorities to (1) purchase the first two rings of homes adjacent to the canal (about 200 homes), (2) relocate the residents of those homes, and (3) begin corrective drainage construction around the canal site. Construction was completed in 1979, and the site was resealed with a new clay cap.

In total over 400 chemicals have been detected at Love Canal, approximately 50 of which have been demonstrated to be carcinogenic in animals in one or more tests and 1 of which, benzene, is a known human carcinogen. Approximately 30 are fetoxic and/or

embryotoxic (that is, can cause miscarriages and stillborn births). In addition, approximately 50 others are mutagenic (that is, can cause changes in an exposed subject's chromosomes or may affect the offspring of the exposed subject) and 60 are neurotoxic (that is, can cause abnormalities in the nervous system, such as tremors and lack of coordination). Many other chemicals are found at Love Canal for which no data exists on potential health effects. Furthermore, little data exists on the effects of exposure to combinations of these chemicals. The uncertainties in this area, particularly regarding sensitive persons such as pregnant women and children, are great.

In August 1978 the Love Canal area was declared a national disaster area by President Carter and was made eligible for Federal disaster relief funds. As a result 239 families in homes bordering the canal were evacuated, their homes purchased by the State, an elementary school built over the center of the canal was closed, and a 6-block area was cordoned off by an 8-foot-high chain link fence. Then, in May of 1980 the President declared that a health emergency existed at the canal and authorized the temporary relocation of another 710 families.

Both EPA and CDC in June 1980 began designing a series of environmental and health studies to determine either that a health hazard exists and people should not return to their homes, or that there is no cause for concern and people should feel confident to return to or remain in their homes. The remainder of this appendix discusses these studies as they were proposed in August and September 1980. Changes that were still in process or being planned after September 30, 1980, are not reflected in this discussion.

ENVIRONMENTAL STUDIES

EPA will be directing an environmental assessment study consisting of air monitoring, surface water and soil monitoring, and modeling and measurement of groundwater movement. EPA plans provide that air monitoring efforts will characterize the quality of air in buildings in the Love Canal area and determine the factors that influence indoor air quality over time--for example, evaporation of chemicals from the groundwater and pumps. Wells will be drilled to obtain soil samples and to monitor groundwater movement and quality. EPA also plans to attempt to develop a model of the groundwater movement in the area to determine if toxic contamination is being spread underground. In June 1980 EPA estimated that these studies would be completed within 6 months.

The EPA environmental studies involve a multifaceted sampling and analytical effort designed to detect and quantify a variety of trace metals, volatile organics, pesticides, and other compounds in soil, sediment, air, animal and plant life, and water

samples. The principal purpose of these activities, according to EPA's August 14, 1980, proposed work plan, is to help assess the extent of the hazard from environmental contamination in the Love Canal area. EPA has stated that the overall exposure of residents must be established as quickly as possible since the area declared a national emergency was extended on May 21, 1980, from those homes directly surrounding the site to a more general area. The proposed work plan also provides that the work is to be performed within an extremely tight schedule. Field sampling activities were to have been completed by October 31, 1980, with all data to have been transferred to the appropriate EPA officials by November 30, 1980. This would, according to planning documents, enable EPA to conclude its evaluations and present the findings by December 31, 1980.

Study design

EPA has divided the area to be studied into 11 strata based on physical boundaries, locations with respect to the canal, and surface drainage patterns. Within 11 strata there are 1,554 estimated dwelling units. Samples of air, soil, sediment, biota, and water will be collected and extensively analyzed within the 11 strata and at selected background sites suitably removed from the area.

Air will be sampled both inside 66 homes and outdoors. Two separate sampling methods are to be utilized for organic compounds because of the wide range of pollutants potentially to be found and the difficulty in efficiently collecting them using one method. Within the homes to be evaluated, samples will be collected in the basement (for those homes with basements) and in the first-floor living area.

Water samples will be collected from those homes with wet sumps; selected streams, rivers, and other surface water; and sewers. Drinking water samples will be collected at representative taps.

Soil core samples will be collected at 235 selected sites. Several sediments in sewers and streams will also be collected. Biological samples will also be obtained during the study to evaluate abnormalities and chemical composition.

Another integral part of the overall program is a comprehensive hydrogeological study of the area to define the movement of the groundwater and to identify the levels of any contaminants presently in the groundwater. This will involve the drilling of 115 pairs of wells consisting of one dug to the top of the underlying glacial till and another dug into the upper part of the underlying dolomite formation. These monitoring wells will allow a determination of the hydrologic characteristics of the aquifers.

Geophysical measurements such as ground penetrating radar, seismic reflection, electromagnetic induction, and magnetometry will be made to help in detailed geophysical mapping of the study area. The information gathered from these hydrogeological investigations will also be used as inputs to groundwater movement models.

The large number of samples to be collected, combined with the very sophisticated level of analysis required, creates an extremely demanding program. Approximately 20 subcontractors will be required to prepare the sampling media, collect the samples, analyze the samples, prepare quality control standards and spikes, and perform the hydrogeological studies. The project has been organized so that several individuals with appropriate skills will be directing the subcontractor efforts.

Number of samples

The following chart illustrates the samples to be taken and types of analysis to be performed.

Samples To Be Analyzed

Type of analysis	Medium				
	Air	Water	Soil	Sediment	Biota
Volatile organics	1,500	600	435	110	50
Semivolatile organics	-	600	235	70	50
Pesticides	1,000	600	235	70	50
Total organic carbon	-	232	-	-	-
Total organic halides	-	232	232	-	-
Metals	169	600	235	70	-
Anions	-	600	-	-	-
Organic method study	-	-	40	10	-
Dioxins	10	10	15	45	-

Cost estimate

Based on the August 14, 1980, Proposed Work Plan for the Love Canal Monitoring Project and other cost estimates, the EPA environmental studies will cost approximately $5.8 million, as follows:

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Cost category		Cost estimate
Direct labor		$ 192,812
Labor overhead		290,254
Travel		99,913
Purchased materials		87,764
Other direct costs		155,207
Subcontracting:		
Sample analysis	$1,945,919	
Well drilling	492,850	
Supervisory geologist services	245,792	
Sample preparation and spiking	80,790	
Sample collection services	552,191	
Geophysical surveying	218,555	
Geophysical modeling services	84,063	
		3,620,160
General and administrative expense		133,383
Fee or profit		252,105
Total estimated cost based on August 14, 1980, Proposed Work Plan		$4,831,598
Cost increase since August 14, 1980, Proposed Work Plan		570,000
Total		5,401,598
EPA costs (that is, travel, equipment, personnel) prior to contract		438,000
Total		$5,839,598

HEALTH STUDIES

The health studies at Love Canal will be directed by CDC. The studies are being planned in two phases and will be accomplished over various time frames. The studies will be carried out through a cooperative agreement between CDC and the State University of New York at Buffalo.

The pathways for chemical migration at Love Canal have been demonstrated to be many and varied. The chemicals in the surface soil may have entered humans through inhalation of contaminated dirt and dust or may have been absorbed through the skin of the feet, hands, and any other portion of the body touching the soil. The sumps in the basements of homes may have drawn in contaminated groundwater and allowed chemicals to volatilize into the air of the home. When the storm sewers backed up, the contamination in the sewers entered the basements through the drain pipes. If

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the leaching or sewer backup flooded basements, exposure through direct contact was likely. Further, exposure may have occurred through contaminated drinking water, though direct evidence is unknown at this time.

Many past studies have examined various health aspects of the Love Canal residents. For example:

--New York State Department of Health Epidemiological Data. The State concluded that there appeared to be a higher than normal rate of fetal death in the mid-1960s and suggested that there may be higher incidence rates along the routes of the old water drainage pathways (swales). Both EPA and HHS reviewed the State data and concluded that it did show (1) an increase in miscarriages and low birth weights in some areas of Love Canal and (2) the methodology used was state of the art and was necessarily conservative. The conclusion was also drawn that exposure to a chemically contaminated environment did cause adverse health effects among the population at Love Canal. Furthermore, EPA and HHS concluded that while it was not possible to conclude unequivocally that the elevated miscarriage rate was caused by the chemicals at Love Canal, it can be stated that excess miscarriages would be expected.

--Dr. Beverly Paigen's Epidemiological Study (March 1979). Dr. Paigen of the Roswell Park Memorial Institute in Buffalo, New York, performed an epidemiological study that indicated a higher miscarriage rate and higher incidence rates of other diseases, such as cancer, for residents of the Love Canal area. EPA has drawn no scientifically certain conclusions due to limitations similar to those affecting the New York State epidemiological study data. Dr. Paigen reported that the general conclusions of her study support those of the New York State study. EPA and HHS concluded that the concerns and questions raised in this study were important and merited attention.

--EPA Chromosome Study. In May of 1980, the results of an EPA-contracted cytogenetic study indicated that there may be an unusual level of chromosome damage in the 36 Love Canal residents tested. However, the study, as designed, did not establish the fact that chemicals from the site caused the reported damage. The study stated that "* * *" in the absence of a contemporary control population prudence must be exerted in the interpretation of such results." EPA has concluded, however, based on this work, that a more extensive chromosome study is warranted.

Study design

Representatives from EPA, HHS, and the Federal Emergency Management Agency indicated in a June 4, 1980, letter to the citizens of Love Canal that the health studies would be completed within 6 months. We found, however, that negotiations between EPA, HHS, CDC, the Office of Management and Budget, and the State University of New York at Buffalo on the exact nature and costs of the studies were still underway in late September 1980. The following discussion is based on the studies planned at that time.

The health studies are being planned in two phases. The first phase will consist of general health examinations for all Love Canal residents who want them. The examinations will include medical histories, physical examinations, and selected laboratory tests. The results of these individual tests will be reported directly to the person tested and to his/her physician if desired. The examinations, according to the June 4, 1980, letter, would be completed within 6 months.

The second phase of the health studies will consist of a series of special in-depth clinical and epidemiologic studies comparing findings in selected Love Canal residents with findings in carefully matched residents outside of the Love Canal area. Particular studies are being considered with respect to possible chromosome abnormalities, neurologic damage, reproductive effects, and immunologic impairment. The June 4, 1980, letter to the Love Canal citizens provided that the design of such special studies and the selection of the persons to be included in them is a very painstaking process, requiring thorough review by panels of scientific specialists. It added that the design phase is expected to be completed within 6 months with some, if not all, of the studies underway at that time. The letter also stated that it was unwise at that point to predict exactly when the studies may be finished due to their complex nature and the difficult scientific methodology involved. Some results, however, may be expected within the year with more complete results becoming available later.

Health examinations

A complete medical examination will be offered to each person who was a resident in the Love Canal area as of June 1978, estimated by CDC to be approximately 4,000 people. Examinations will consist of a medical history interview, blood and urine laboratory tests, physical examination, and clinical diagnostic followup and consultation as needed. An information sheet describing the nature and purpose of the medical examination will be provided and discussed with each participant. This sheet will be combined with participant consent and medical record release forms whereby the participant may consent to the medical examination alone or may also ask to be considered for inclusion

in any of the three comparison studies. The consent form will also provide means whereby each participant may choose or not to undergo the psychologic testing components of the individual medical examination. The time sequence of examination components will start with a medical history interview followed by blood and urine specimen collection 2 days later and by physical examination and physical consultation about 3 weeks later.

Special studies

Three comparison studies (chromosome aberrations, nerve conduction slowing, and pyschologic reactions) will compare selected Love Canal residents with two different samples of non-Love Canal residents. With the exception of two phases of the chromosome work, participants will be chosen from randomly selected households in each area: (a) the Love Canal area, (b) a comparable area in Niagara Falls distant from Love Canal, and (c) a comparable area outside of Niagara Falls but near enough so that selected participants can be examined at the same time as Niagara Falls participants. Individual participants will be enrolled in only one study each, with as many as three participants coming from individual households (one each for chromosome, neurologic, or psychologic testing, for instance). Each non-Love Canal participant will receive the general medical examination offered to all Love Canal participants and will be given up to $50 for travel/time reimbursement. Households in the three comparison areas will be selected applying a table of random numbers to a complete enumeration of households in each area.

The Niagara Falls comparison area consists of two parts. The first contains no dump sites and is considered too distant from Love Canal to be affected by chemical leaching in soil or airborne chemical spread. The two census tracts are closely similar in socioeconomic makeup, except for racial composition. To provide adequate comparison for the largely black rental population group in the Love Canal area, the second comparison area will be a racially comparable rental project.

Cost estimate

Based on a September 18, 1980, memorandum from the Secretary, HHS, to the Director, Office of Management and Budget, the Love Canal health studies were projected to cost $5 million. The project was expected to be carried out through a cooperative agreement between the State University of New York at Buffalo and CDC. The allocation of the project costs by year are shown in the following table.

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Fiscal year	Projected costs		
	CDC	Cooperative agreement	Total
	- - - - -(000 omitted) - - - - -		
1980	$ 140	$ 500	$ 640
1981	1,010	2,700	3,710
1982	150	500	650
Total	$1,300	$3,700	$5,000

It is expected that approximately $2.7 million of the projected costs will support health examinations while the remaining $2.3 million supports the special studies.

EXPECTED RESULTS

Since precise chemical exposure information is not available for individual Love Canal residents and since the present investigation will be performed more than a year after remedial measures were taken at the site, CDC in a program description of the Love Canal health studies stated that it was unlikely that the proposed studies would provide definitive scientific links between particular chemical exposures and subsequent health effects. CDC also believed it unlikely that any striking increases in overt health effects would be seen or that large differences in population health status attributable to canal exposure would be detectable. Nevertheless, CDC believed that a thorough effort must be made to discover effects if they exist, in face of the great level of local concern and the sequence of events which have led to the present Federal commitment to conduct health studies.

Between EPA and HHS more than $10 million is expected to be spent on the Love Canal environmental assessment and health studies. Love Canal is one site. EPA has already identified nearly 8,700 potential sites.

Even with the expected expenditure of over $10 million at Love Canal, we found no individuals within EPA or outside of it believing that the health effects experienced by Love Canal residents will be conclusively linked to chemicals at the site. Some EPA officials believed that the Love Canal studies will have applicability at other sites, if nothing more than to demonstrate what should or should not be done.

HHS officials have been quite vocal in the media about the inability of science to link the canal's chemicals with health effects. Both the Director, National Institute of Environmental

Health Sciences, and the Director, Chronic Diseases Division, Bureau of Epidemiology, CDC, commented in the August 11, 1980, edition of Chemical and Engineering News about what can be scientifically said regarding the health effects at Love Canal. During discussions with these officials in September 1980, we confirmed what was quoted. We also gained wide agreement from other officials in HHS and EPA on the accuracy of their statements.

The Director, Chronic Diseases Division, Bureau of Epidemiology, CDC, in commenting on the types of studies that can now be devised to show a cause and effect relationship between exposure to toxic chemicals and disease, stated:

> "* * * It is a difficult problem to say a low-level exposure to this or that chemical, let alone to these chemicals in combination, does or does not cause illness. Most of the chemicals cited at Love Canal appear to be at low levels. We know from traditional acute toxicological principles that these aren't the kinds of levels one would expect to produce outright acute toxicity. But the concerns here deal with unknown and rare effects. That, plus the fact that we are dealing with chemicals acting in combinations that have never been tested, makes it difficult to predict even which effects should be looked for."

The Director, National Institute of Environmental Health Sciences, succinctly defined the scientific limits that exist. He stated:

> "The important scientific problems at Love Canal are that little is known about the toxicity of the chemicals, and that it is difficult to use health surveys and epidemiological studies to associate exposure to chemicals from dump sites with human health effects. We do not have markers that help us associate disease with prior chemical exposure. Moreover, in a statistical sense, most dump areas impact on the health of relatively few people, and it is difficult to detect relatively rare events in small populations. Because we can't generalize about the toxic effects of multiple chemical exposure, it is almost impossible to estimate the health impacts of such exposure other than to assume that they are simply additive."

APPENDIX II

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

SEP 17 1981

OFFICE OF
PLANNING AND MANAGEMENT

Mr. Henry Eschwege, Director
Community & Economic Development Division
United States General Accounting Office
Washington, D.C. 20548

Dear Mr. Eschwege:

The Environmental Protection Agency (EPA) has reviewed the General Accounting Office (GAO) draft report entitled "Hazardous Waste Sites: An Increasing Public Health and Environmental Problem."

We believe that the report is generally accurate and presents the problem in an organized and well-documented manner. The report may tend to overemphasize the late start the Agency had in addressing abandoned hazardous waste sites, without giving adequate weight to the limited legislative authority available.

The report points out that EPA has a mandate to protect the public from hazardous wastes, but the mandate, derived from the Resource Conservation and Recovery Act, is primarily concerned with regulation of future hazardous waste practices. The foremost mandate to remedy abandoned hazardous waste sites is derived from the recently enacted Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (Superfund). The report correctly illustrates the magnitude of the problem, but should not be interpreted to suggest that funding may be sufficient. The Agency does not predict that 1.6 billion dollars will be enough to make more than a reasonable start on the problem.

The report indicates that the sampling problems faced by Agency personnel are based on professional judgment rather than a scientific basis. It may be more correct to say that since each site is reasonably unique, sampling decisions do not easily fit into a uniform national protocol. Nonetheless, the Agency does use technical guidelines to control sampling for investigation, assessment and evidence gathering.

The report indicates quite properly that research to develop good biological testing methods should be substantially increased. The Agency would not, however, expect that biological screening tests will soon replace chemical testing, but rather that adequate biological screening procedures would allow the Agency to focus its limited chemical testing capability on the most pressing problem sites.

We believe that the report should have covered some of the more active State programs and some of the Agency's efforts to aid and develop these programs. This area of involvement will certainly grow rapidly along with development of the Superfund program. A positive recommendation in this area may be useful to the Administration.

The report has a very good discussion of the effects of the use of a "potential harm" argument versus a demonstration of actual harm, but draws a conclusion in Chapter 4 which overstates the case. The report indicates that this approach requires less evidence and allows the Government to pursue "as many enforcement cases as it can ...," when it would be more proper to conclude that "it allows the Government to pursue more cases than it otherwise could with its limited resources." Substantial evidence is still required to sustain "risk of harm" arguments.

[GAO note: We have revised the body of chapter 4 to more clearly state that substantial evidence is still required to sustain "risk of harm" arguments.]

The statement in Chapter 4 regarding the cost of cleanup work on the central Florida phosphate slag problems is much too low. A figure of 1.2 million dollars is closer to the cost of cleaning up one site, rather than the generic problem.

[GAO note: We have included this information in chapter 4. (See p. 41.)]

The cost figures given on sample costs are somewhat misleading. For example, the cost cited, $1,600 to 1,800 per sample, is more realistic for the cost to obtain and analyze a sample; not the cost to analyze, as inferred in the report.

[GAO note: The cost figures referred to are on page 20. We disagree that these figures are misleading since they represent simple mathematical computations. The fiscal year 1981 budget states "*** a $8-$9 million series of chemical analysis contracts for analyzing samples obtained during the site investigations." As this statement shows, the chemical analysis contracts are for "analyzing samples obtained during the site investigations," not for "obtaining and analyzing samples" as indicated in EPA's comment.]

APPENDIX II

EPA's Office of Research and Development takes a strong position that the order of priorities determined by the report, as suitable for research and development activities, is not consistent with the order determined by our internal management using the zero based budgeting process.

The report makes many constructive criticisms and has managed to present a balanced evaluation of a most difficult environmental problem. The conclusions that the problem is large, complex, resource intensive and not yet fully defined are true.

The report properly identified many of the scientific needs and problems which the Agency faces and also properly points out the difficulties of taking strong enforcement positions in the absence of legislative authority in new areas.

We appreciate the opportunity to comment on the report's content.

Sincerely yours,

C. William Gamse

Roy N. Gamse
for Acting Assistant Administrator
for Planning and Management

APPENDIX III

NATIONAL SCIENCE FOUNDATION
WASHINGTON, D.C. 20550

OFFICE OF AUDIT
AND OVERSIGHT

February 23, 1981

Mr. Morton A. Myers
Director
Program Analysis Division
U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Myers:

We have reviewed those parts of the GAO draft report on "Hazardous Waste Sites: An Increasing Public Health and Environmental Problem" concerned with NSF. We have no objections or comments.

Thank you for the opportunity to examine the draft.

Sincerely yours,

Jerome H. Fregeau
Director
Office of Audit
and Oversight

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